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ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES
APPLE, CITRUS AND POTATO PROCESSING SEGMENTS OF THE CANNED AND PRESERVED FRUITS AND VEGETABLE INDUSTRY

Development Planning and Research Associates,
Incorporated

PREPARED FOR
Environmental Protection Agency

February 1975

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The economic impacts of proposed effluent guidelines on selected portions (citrus, apples and potatoes) of the fruit and vegetable processing industry were assessed. The analysis included description and statistical compilations regarding the number, location and characteristics of types of firms and plants; financial profiles, investments, operating costs and returns for selected model plants; prices and pricing mechanisms; description of analytical procedures employed; evaluation of costs of proposed effluent treatment practices; and economic impacts of proposed pollution controls in terms of effects on prices, industry returns, production, employment, community economics and international trade. Limits of the analysis were stated.

Specific segments of the citrus (single strength canned juice) and apple (small slices and sauce plants) processing industries will be severely impacted both by the BPT (1977) and BAT (1983) levels of control. Some plants are projected to shutdown

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due to control requirements including a more rapid closure of plants which might otherwise operate until equipment was worn-out.

Approximately two-thirds of the plants involved are reported either to be linked to municipal treatment systems or to have land disposal (spray irrigation) systems. According to EPA these systems will meet control requirements. Because of this, overall industry impacts are effectively reduced. However, individual plants projected to shutdown will cause serious local community effects including employment losses that often cannot be readily absorbed in the affected communities.

EPA 230/2-74-012
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February, 1975

Prepared for
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Environmental Protection Agency
Washington, D. C. 20460

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This report has been reviewed by the Office of Planning and Evaluation, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

PREFACE

The attached document is a contractor's study prepared with the supervision and review of the Office of Planning and Evaluation of the U. S. Environmental Protection Agency (EPA). Its purpose is to provide a basis for evaluating the potential economic impact of effluent limitations guidelines and standards of performance established by EPA pursuant to sections 304(b) and 306 of the Federal Water Pollution Control Act.

The study supplements an EPA technical "Development Document" issued in conjunction with the promulgation of guidelines and standards for point sources within this industry category. The Development Document surveys existing and potential waste treatment and control methods and technologies within this category and presents the investment and operating costs associated with various control technologies. This study supplements that analysis by estimating the broader economic effects (including product price increases, continued viability of effected plants, industry growth and foreign trade) of the required application of certain of these control technologies.

This study has been submitted in fulfillment of Contract No. 68-01-1533, Task No. 4 by Development Planning and Research Associates, Inc. Work was completed as of February, 1975. The study is based primarily upon an earlier study, also prepared by Development Planning and Research Associates, Inc. entitled "Economic Analysis of Proposed Effluent Guidelines, Fruit and Vegetable Processing Industry."

The earlier report was circulated in conjunction with the publication in the Federal Register of a notice of proposed rulemaking under sections 304(b) and 306 for the subject point source category. The analysis contained in the original study has been revised based upon information received during the period of time between publication of the notice of proposed rulemaking and the promulgation of the final regulation. Because of the constraints of time, the control and treatment costs analyzed in this study may not in all instances be identical to those associated with the requirements of the promulgated regulation. However, those differences, when they exist, are minor insofar as the final conclusions of the study are concerned.

This report represents the conclusions of the contractors. It has been reviewed by the Office of Planning and Evaluation and approved for publication. Approval does not signify that the contents necessarily reflect the views of the Environmental Protection Agency. The study has been considered, together with the Development Document, information received in the form of public comments on the proposed regulation, and other materials in the establishment of final effluent limitations guidelines and standards of performance.

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APPENDIX

ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES: APPLE, CITRUS, AND POTATO SEGMENTS OF THE CANNED AND PRESERVED FRUITS AND VEGETABLE INDUSTRY

EXECUTIVE SUMMARY

This report analyzes the economic impact of the imposition of the Environmental Protection Agency's effluent guidelines on the apple, citrus, and potato segments of the canned and preserved fruits and vegetable processing industry.

I. INTRODUCTION

The present study analyzes the economic impact that will result from the imposition of EPA's effluent control requirements on specific portions of the Dehydrated (SIC 2034), Frozen (SIC 2037), and Canned (SIC 2033) Fruits and Vegetable processing industries. Although the study initially proposed the inclusion of the asparagus and spinach processing industries, the inability to present specific effluent control cost data made that part of the study impossible. Too, the potato processing industry's section of this report, because of the unavailability of data, is necessarily preliminary and tentative and is presented in Appendix A.

In addition to other government and public data sources, contacts with industry representatives, and the Contractor's previous studies, the data for the present study were taken from the Census of Manufactures and the Directory of the Canning, Freezing, Preserving Industries. The combined data sources and DPRA's adjustments of them adequately represent the industries studied.

II. INDUSTRY SEGMENTS

This chapter describes the characteristics of those industry segments that are studied in this report. Specifically, the chapter considers the number and size of firms, their degree of integration, their concentration, employment, and payroll. Incidental to these considerations will be a description of the freezing, canning, and dehydrating processing firms' organizational structure and product mix.

A. Characteristics of Fruit and Vegetable Canning, Freezing, and Dehydrating Firms

Plant and Firm Data

Although plant data and firm size are not available for dehydrating plants, such information for canning and freezing plants were examined. The canning industry's plant size data indicate that of the analyzed firms 36% are small (less than 250,000 annual cases), 29% are large (over 1,000,000 cases), and 10% are very large (over 5,000,000 cases). Recent data indicate that industry plant closures predominantly affect small plants. The data also indicate that large, multi-product plant firms are increasing their percentage of the industry's production. The period from 1970 to 1973 saw a net decrease in the number of canning plants.

The freezing industry plants where categorized as small (less than 5,000,000 pounds of annual volume), large (over 20,000,000 pounds annually) and very large (over 100,000,000 pounds annually) also show the increasing importance of the middle and larger size plants and firms. The freezing industry shows, in recent data, a net increase in plant numbers.

Industry Integration, Diversification, and Specialization

Industry data indicate that the processing industry has little vertical integraion of ownership, depending for its raw product and sales upon independent growers (including contract growers) and sellers. Despite the prevalence of multi-product plants handling a wide variety of processed products, pre-1968 data indicate that industry is characterized by high (90+ %) specialization ratios of primary to secondary products. In general, industry concentration--when measured by value of shipments --is greater for the canned and dehydration segments of the industry than for the frozen fruit and vegetable segments; however, 1963 to 1970 data indicate that larger frozen food firms are increasing their share of the industry's output.

B. Number of Plants and Employees in Each Segment

Data from the 1967 Census and the Directory for 1972-73 indicate that the industry labor force is primarily concentrated in the canning industry with 100,100 employees. The freezing segment employees 64,300 and the dehydration, 11,100. Overall canning industry employment has trended downward; employment in the freezing segment has increased from 39,500 in 1958 to 71,800 in 1970.

C. Characteristics of Fruit and Vegetable Canning, Freezing and Dehydrating Plants

In the absence of dependable data for dehydrating plants, this discussion emphasizes the plant characteristics of the canning and freezing segments of the industry.

Number and Location of Plants

The freezing and canning industries are made up of 1,205 plants: 828 fruit and vegetable canners, 196 fruit and vegetable freezers, and 181 combination canning and freezing plants. Generally speaking, these plants are widely dispersed across the nation, although concentrated most heavily in the North Central and the Pacific Regions.

Plant Characteristics

Small, single-plant firms predominate in the canning and freezing industries. When classified by products, 55% of the canning plants handle only vegetables, 21% only fruit, and 24% both fruits and vegetables. A relatively large percentage of freezer plants process only fruits, 41%, and 39% process only vegetables. Approximately 70% of all canning, freezing, and combination canning-freezing plants are multi-product plants.

Plants: Age, Technology, and Efficiency

Though a high proportion of industry plants are relatively old, the industry has generally maintained modern technology through renovation and equipment modernization. Excess capacity does exist, however. Utilization of capacity is higher in larger plants and in intensive, commercial production areas.

D. Characteristics of Specific Product Segments of the Industry

Citrus Plants

Data from 1972-1973 reveal that only 39% of all citrus producing plants process only citrus products, 67% process only fruit (citrus and other), and 33% process fruits and vegetables. Sixty-five percent are canners, 16% are freezers, and 19% are combination freezer-canner plants. Size data by volume packed indicate that approximately 33% are small plants, 40% are medium and 25% are large plants. Approximately 60% of the plants are multi-product plants. Thus, apparently, the typical citrus plant is a small to medium processor, processing many citrus and other fruit products. Citrus plants employ approximately 18,615 workers; 1,980 by small plants, 6,235 by medium, and 10,400 by large plants.

Apple Plants

Data indicate that 80% of the apple processing plants process other fruits and vegetables. Most (67%) are canners, 19% are freezers; the remainder can and freeze. Forty-four percent are small plants. Forty-two percent process six or more products other than apples. Apple plants employ 25,155 workers: 3,465 in small plants, 6,090 in medium, and 10,400 in large plants. In summary, the typical apple processing plant is a small canner processing a diversity of products.

Spinach Plants

Forty-two firms process spinach in 52 plants. Approximately 50% are canning plants. Data indicate that 58% of the processing plants handle only other vegetables; and 42% process fruits in addition to vegetables. Small plants account for 17% of the plants and 54% are large ones. No plant processes only spinach and 70% of the plants process at least six other fruits or vegetables. Spinach plant employment distribution is: small plants, 495; medium, 2,175; and large plants, 11,200.

Asparagus Plants

Asparagus processors (58 firms, 60 plants) are mostly canners who process a variety of other fruits and vegetables. Sixty percent of asparagus plants are small or medium sized and 40% are large. There is no plant processing asparagus only.

Potato Plants

Eighty-nine firms use 103 plants in canning and freezing potato products. Twenty-nine plants process only potatoes. Small plants employ 1,265 workers, medium, 4,495, and large plants, 19,600. Data were not available for potato dehydration plants.

Dehydration Processors

Data are not available for a sound description of industry and plant characteristics; consequently, this report will emphasize only canning and freezer plant and industry characteristics and projections.

E. Specific Products Relative to the Industry

Proportionate Volume Packs of Specific Vegetables and Fruits in the Processing Industry

Asparagus, spinach, and white potatoes account for relatively minor portions (7% combined) of the total canned vegetable pack. Spinach and asparagus account, also, for a very minor part of the freezing total volume (3.0% and 0.6% respectively). White potatoes, however, are quite important and account for 56% of the total frozen food pack. Apples, applesauce, and apple juice constitute 20% of the total canned fruit and fruit juice pack. Twenty-three percent of the canned fruit and fruit juice industry consists of canned citrus products. Frozen apples and applesauce make up 15% of the total frozen food pack. Again, citrus fruits and juices account for a significant portion of the frozen food pack.

F. Significant Impacts in the Industry

The competitiveness of the food processing industry and the unique structure of that industry dictate that the imposition of effluent control requirements will seriously affect the industry. The smaller and some of the medium-sized plants may not be able to survive the added costs. Doubtless, the extent of economic effects will depend upon a variety of factors; plant size, profitability, location and availability of low cost treatment plans, and present waste-water treatment facilities. Of major consideration is the fact that though the canning and freezing processing industries have a high number of small plants, these plants are generally, because of their size, location, and production inefficiencies, producing too small a portion of the pack volume to be successfully competitive once effluent control costs are added to their present cost structure. These firms must be presently considered marginal and will probably be forced to close.

III. FINANCIAL PROFILE

This chapter presents the financial characteristics of three product segments of the fruit and vegetable processing industries--citrus, apples, and spinach. In order to facilitate the eventual determination of pollution control costs, the study analyzed industry financial data on the basis of three model plant configurations: small, medium, and large plants. The analysis synthesized representative cost and return data for the model plants and projected economic data for a twenty-year period. The models included EPA's estimated pollution abatement costs and considered production both with and without internal pollution abatement controls.

A. Model Plants by Segment

Citrus Plants

Small, medium, and large plant models were developed for frozen concentrated orange juice and single-strength, canned orange juice. Plant production was based upon a six month, 16 hour per day average (2,880 hours). Frozen orange concentrate accounts for 93% of the total frozen citrus concentrate pack. The costs of processing canned orange juice are similar to those for other canned juices.

Apple Plants

Models were developed for plants processing canned slices, canned sauce, canned juice, and frozen slices. Plant data were based upon a 900 processing hour season.

Spinach Plants

Models were constructed to reflect industry data for both the freezing and the canning of spinach. Plant data reflect a 500 hour processing season.

B. Model Plant Configuration

Model Data

The model plant data were projected from authoritative sources. The models assumed: (1) operations at 90% of capacity, (2) revenues based upon f.o.b. prices for the canning year, (3) raw product costs developed on the basis of raw tonnage necessary for projected throughputs, (4) direct costs for labor, product additives, containers, fuel, and overhead, (5) indirect costs for management and sales, (6) depreciation, and (7) interest costs.

Summary of Model Plant Data

Raw product costs vary from 10% for the spinach canning plants to 55% for the frozen concentrated orange juice plant. The relationship of between processor costs and other direct and indirect costs ranged from 32% for frozen orange juice to 77% for canned spinach. Depreciation, calculated on the basis of replacement costs ranged from 1% to 5% of sales.

Annual Profit Before Taxes

Pre-tax returns on average capital varied directly by plant size except for those of the citrus industry. The range was from a negative return for all sizes of frozen apple plants to a high of 53% for the large spinach canning plant. Frozen orange juice concentrate had a higher return than did canned single strength. No causative relationship existed between cost of processing and size of operation in the citrus industry. Low returns were found for both the frozen apple and frozen spinach plants.

C. Ability to Finance New Investment

Data indicated the apparent availability of capital required to finance pollution control costs for large and medium-sized canners and, especially, freezers. However, individual plants and specific local considerations may have unique overriding conditions that preclude the use of such available capital. Capital availability is not promising for small plants, especially for those which have depreciated out original investment costs and consider their investment as "sunk capital" and find "utility value" in continued operations. Even in cases where capital may be available, its terms may be unattractive to both lender and borrower. Continued operations in such cases will be based on other than an economic rationale.

IV. PRICE EFFECTS

This chapter considers the effect that pollution control costs will have upon prices in the processing food industry segments under consideration.

A. Price Determination

Conditions in the food processing industry have resulted in a highly competitive industry. Prices are determined by demand and supply considerations.

Demand

The principal demands for processed foods comes from retail food concerns, government purchases, institutional purchases, and processed food "manufacturers." Long-run demand is affected by dietary patterns and technological changes in production and transportation.

Data indicated that the demand for canned and frozen vegetables and fruits will increase steadily, though not dramatically, and that the increase will be at the expense of the fresh food industry for vegetables. The increase in the demand for frozen fruits will reflect an increase in total fruit consumption. The demand for potato products has changed markedly during the past decade and reflects the growing interest in processed potato products, especially that for frozen French fries (from 7 lbs. per person in 1960 to 32.5 pounds in 1972). Though the changes stem, in part, from technological changes in production, they also indicate the increased demand for convenience foods. Export and import data indicate that, except for such specific foods as tomato products, pineapples, mushrooms, and berries, international trade determinants have relatively little effect on processed vegetable and fruit prices. Government purchases for frozen and canned products, though substantial, exert no pricing dominance in the industry.

When compared to other retail trade expenditures, all food sales amount to but 4.7% of all retail expenditures. When fresh food expenditures are deleted, the processed canned and frozen vegetable and fruit expenditures share of the retail market falls to less than 2% of retail sales. The data indicative of total food sales reveal that expenditures for fruits and vegetables (excluding potatoes) comprise 8.1% and 8.3% of all retail food sales. Half of this amount is for fresh products; canners absorb 3.2% and freezers, 1.5%.

Supply Characteristics of the Fruit and Vegetable Industry

The fruit and vegetable canning and freezing industries tend to locate near raw product producing areas to insure their sources of supply and the quality of those supplies. Consequently, the industry has a widespread network of plants that tend to be multi-product processors to increase the efficiency of their production. The industry uses large numbers of relatively low-skilled workers and a relatively low percentage of highly skilled technical and management personnel. Because plant technology has changed appreciably, small, obsolete plants are marginal producers. Considerable economics of scale account for much of the decrease in plants. Two considerable determinants of supply and, therefore, costs in the industry are its characteristic under-capacity operations and its relatively brief operating seasons.

Pricing

Fruit and vegetable canning and freezing industries operate within a stable but highly competitive industry climate. Prices are determined by pack, stocks, and national economic conditions rather than by oligopolistic price management at one extreme or by irresponsible competition at the other. Though some specific products have demonstrated greater historical variations in price and margins at grower, wholesaler, and retailer levels, packs, stocks, and national economic conditions generally have determined prices.

B. Expected Price Changes

If the industry successfully passes pollution abatement costs to consumers, the price increases would amount to approximately 1% to 2%. Such would have little impact on consumption patterns. If all costs were passed forward, a decrease of 0.5% to 1% (1 to 2 pounds per capita) could be expected. This would be less than the total annual increase in consumption resulting from population expansion and projected increases in per capita consumption.

Projected Plant Utilization

Plant shutdowns among small and marginal producers can be anticipated wherever such plants have no abatement systems presently. The competitive structure of the industry will encourage such plant closings.

Projected Price Response

Industry conditions indicate that processors will have difficulty in passing added costs forward for products with stable demand than they will for those such as citrus products with rising demand. Grower margins are sufficiently small to prevent a backward passing of costs. Most price effects, therefore, must result in increased consumer prices. Processors, wholesalers, and retailers will absorb minor increases for specific products with stable demand trends.

Locational Impacts

Many of the small, marginal processors expected to close are located in regions already economically depressed. Plant closings at such sites will greatly affect local economic conditions and will be far more substantial in effect than overall industry economic dislocations.

Secondary Impacts

Industry growth will not be significantly altered by the imposition of pollution control costs. Expected and normal patterns of increased demand will offset any short-run declines in per capita consumption. On an industry-wide basis, there is no expected substitution effects from the use of fresh vegetable and fruit products. The convenience and availability of processed products will continue to attract consumers. Although international trade data indicate that specific products will be affected by domestic price increases, overall vegetable and fruit prices will not alter established trade patterns.

V. ECONOMIC IMPACT ANALYSIS METHODOLOGY

The economic impact analysis utilizes the basic data developed on industry segments, financial profiles and price effects, together with pollution abatement technology and costs developed by EPA. Impacts analyzed include:

- Price effects
- Financial effects
- Production effects
- Employment effects
- Community effects
- Foreign trade effects

The determining force of plant shutdowns on these impacts is crucial; consequently, the financial and production effects which most immediately reflect plant shutdowns, were given most emphasis in this analysis.

In general, the approach used can be simply stated as the problem of deciding whether a commitment of time or money to a project is worthwhile in terms of the expected benefits. The primary factors involved in assessing the financial and production impact of pollution control are profitability changes and these, in turn, are a function of the cost of pollution control and the ability to pass along these costs as higher prices. In reality, of course, closure decisions are seldom made on the basis of well-defined economic rules. Such decisions invariably include a wide range of personal values, external forces such as the ability to obtain financing, or the role of the production unit in an integrated larger cost center.

However, the analysis was made on the premise that economic returns in the industry would be the primary determinants of plant closures. In the most fundamental case, a plant will close when variable expenses (Vc) are greater than revenues (R). A more probable situation is the case in which $Vc < R$, but revenues are less than variable costs plus fixed, short-run cash overhead expenses (TC_c). In this situation a plant would likely continue to operate in the short-run but would be forced out over a longer period of time. Necessary to such a situation is the firm's expectation that revenues will increase to cover total cash outlay. Identification of plants where $TC_c > R$ but $Vc < R$ leads to an estimate of plants that should eventually close if revenues do not increase.

The next level of analysis, where $TC_c < R$, involves estimating the earnings before and after investment is pollution abatement. Under conditions in which $TC_c < R$, it seems likely that investment in pollution control will be made and that plant operations will continue so long as the capitalized value of earnings (CV) is greater than the salvage value of the sunk investment of the plant. Computation of CV involves discounting the future earnings flow to the present worth. Discounted internal rates of return (the computed discount rate, or yield, which produces a zero present value of the cash flow) was the measure of profitability used. These rates of return, with and without pollution controls and the estimated salvage values of plant, equipment and land were the major factors used to determine potential plant shutdowns.

Price Effects

In order to provide a standard to reflect price effects, an estimated price adjustment sufficient to offset required pollution control costs weas calculated. Application of the discounted cash flow procedure to pollution control costs yields present values and from this the price increase required to pay for pollution control was calculated by the formula:

$$X = \frac{PVP\ (100)}{(1-T)\ (PVR)}$$

where: X = required percentage increase in price
PVP = present value of pollution control costs
PVR = present value of gross revenue starting in the year pollution control is imposed

Production Effects

A study of the technological characteristics of the industry and of industry production practices underlay the analysis of probable changes in plant capacity utilization and in the industry's ability to absorb capacity losses as marginally productive plants are closed.

Employment Effects

Given the production effects of estimated production curtailments, of plant closings, and of changes in industry growth, employment effects were estimated on the basis of known production-employment relationships.

VI. POLLUTION CONTROL REQUIREMENTS AND COSTS

Water pollution control requirements and costs used in this study were furnished by EPA and were adapted to the various model plants studied for the apple, citrus fruit, and potato processing segments of the fruit and vegetable processing industry.

Three effluent control standards were employed:

BPT - Best Practicable Control Technology Currently Available, to be achieved by July 1, 1977.

BAT - Best Available Pollution Control Technology Economically Achievable, to be achieved by July 1, 1983.

NSPS - New Source Performance Standards, applicable to any source for which construction starts after publication of the proposed Standards regulations.

No pretreatment controls were considered necessary for any of the model plants. Industry characteristics justified considering NSPS standards to be equal to BAT standards.

To achieve the proposed standards the fruit and vegetable processing plants have a diverse pattern of control alternatives that may be successfully employed. Because of EPA's estimated control costs were for plant sizes not strictly reflective of DPRA's model plant configurations, the Contractor adopted linear functions to extrapolate and interpolate necessary data for the specified model plants.

Present Status of Wastewater Treatment

Approximately 66% of the plants in the citrus and apple processing industries utilize municipal or land irrigation waste disposal systems. These plants are not expected to be affected by the EPA standards. The remaining one-third of the plants have none or only partial treatment facilities. Though some currently meet BPT requirements, nearly all would require further treatment to achieve the BAT standards.

VII. IMPACT ANALYSIS

This chapter analyzes the impact of the imposition of pollution control standards on the citrus and apple processing industries. Considered are the effects on the industries' prices, financial conditions, production, employment, international trade, and community relationships. These effects under BPT and BAT control standards are as follows:

The foregoing analysis of the citrus and apple processing industries indicates that specific segments of these industries are likely to be impacted severely on the basis of model plant effects. A broad range of effects were considered and a brief summary of the main effects estimated for both BPT and BAT levels of control is as follows:

Type of Impact	BPT (1977)	BAT (1983)
1. Price Effects		
Orange Juice - large plants	.5 - .8%	.9 - 1.1%
Apples - large plants	.4 - .9%	.5 - 1.3%
2. Financial Effects	All S.S. Orange Juice and small apple slices and sauce plants incur losses. Plant shutdowns expected.	Same as BPT
3. Production Effects		
• Citrus plant shutdowns		
Baseline	8	10
Above baseline	2	-
• Apple plant shutdowns		
Baseline - No. Plants	12	13
Above baseline - No. Plants	4	-
• Production losses (short term)		
Citrus - Above baseline	6%	
Apples - Above baseline	4%	
4. Employment Effects		
Citrus - Above baseline	1.5%	
Apples - Above baseline	.5%	
5. Community Effects		
Citrus and apples	Employee losses Payroll losses Local multiplier effect loss Farmer impact possible	
6. Other Effects		
Citrus	Potential loss in exports of canned juice	
Apples	Potential increase of imports of apple juice	

VIII. LIMITS OF THE ANALYSIS

This study was based upon data from published secondary sources, government sources, industry consultations, and the Contractor's files. Data are subject to error and variance; this chapter presents the limits of the study in terms of its accuracy, range of error, and critical assumptions. The section also indicates remaining considerations for the industry.

A. General Accuracy

Key financial data on the processing industry are not always available; consequently, this study based its analysis on constructed model plants that, by nature, cannot perfectly reflect actual industry conditions. To counter such a limitation, the Contractor employed a variety of responsible data sources to monitor the accuracy of the model configurations.

The extraordinary range and complexity of product mixes found in the industries' plants make it impossible to accurately reflect all financial and production variables in model plants. The study, however, developed its single-product plant models to reflect typical through-put volumes. Obviously, however, no model could reflect precisely the economic characteristics of multi-product plants.

The model data provided by EPA, because they were not exactingly drawn to this study's models, were modified by the extrapolation and interpolation of data structured by linear relationships. It is possible that some cost-size relationships are not linear. To the extent that such may be true, the effluent control costs used in this study will need modification.

B. Possible Range of Error

The data series employed in this study are subject to error and variance with industry conditions. The estimated error ranges of key items as an order of magnitude are:

	Percent Error Range
1. Number, location, capacity, product mix of plants	± 10
2. Price data for products and raw materials	± 10
3. Sunk investment value	± 20
4. Plant operating costs	± 10
5. Effluent control costs	Not estimated
6. Expected price changes	± 5
7. Estimated plant closures	± 20

C. Critical Assumptions

Basic assumptions reflecting the Contractor's awareness of industry conditions were employed in this study. Such key assumptions were as follows:

1. Single-plant models generally and practically reflect corresponding multi-plant operations.
2. Frozen and single-strength orange juice production adequately reflect other citrus production characteristics.
3. Linear cost-size relationships are adequate to estimate pollution control costs for model plants.

Additionally, key assumptions were made regarding prices, production, raw product supplies, pollution controls presently functioning, alternative control technologies, and pollution control costs. All must be considered in assessing this study.

APPENDIX A

This section attemps a most tentative assessment of the effects of pollution control costs on the potato processing industry. Although proposed effluent guidelines have been established and estimated investment and operating costs for specific plants developed, plant financial data to which these costs would apply were not available from secondary sources nor obtainable by DPRA from trade associations nor private industry sources.

The Appendix presents, briefly, a preliminary estimate of expected impacts from pollution control costs by comparing unit effluent control costs with wholesale prices of processed potatoes. The analysis emphasizes the necessity of a further and more exacting study of this industry.

ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES: APPLE, CITRUS, AND POTATO SEGMENTS OF THE CANNED AND PRESERVED FRUITS AND VEGETABLE INDUSTRY

I. INTRODUCTION

This study analyzes the economic impact of proposed effluent abatement requirement costs on selected portions of the Fruit and Vegetable Processing Industry. These requirements (effluent limitation guidelines) were developed by EPA pursuant to the Federal Water Pollution Control Act Amendments of 1972.

A. Scope

The industrial pollution abatement impacts considered in this report include those applicable to selected portions of the following Standard Industrial Classifications:

SIC 2033	Canned Fruits, Vegetables, Preserves, Jams and Jellies
SIC 2034	Dried and Dehydrated Fruit and Vegetables
SIC 2037	Frozen Fruits, Fruit Juices, Vegetables and Specialties

Within these broad industry groups, emphasis focused on the processing of five specific products: (1) citrus, (2) apples, (3) potatoes, (4) spinach, and (5) asparagus. These products are but a limited cross-section of products in the industry; however, a principal objective of this analysis was to intensively study specific types of operations in relation to water effluent characteristics and control requirements.

The impacts considered were expected to apply directly to some operations, but must be considered on a "prorated" basis for others. Complications were encountered when dealing with specific products due primarily to the wide range of product combinations, product forms and varied processes which, in fact, exist in the industry. For example, processed apple products include sliced apples, apple juices, apple sauce and cider, some of which are canned, frozen or dehydrated. Apples may also be processed in conjunction with other fruits and/or vegetables.

Chapters II-IV present characteristics of the fruit and vegetable industry with a focus on the specific products indicated above. Impact analyses are presented in Chapter VII for citrus and apple products. A preliminary impact analysis of the potato processing industry is presented in Appendix A. Insufficient industry data was available for model plant analysis. Pollution control costs for spinach and asparagus were not available as expected; thus, an impact analysis was not possible. Basic industry information of these segments is presented, however.

B. Data Sources

The most commonly used and in many cases the most readily available shource of industry information including employment, location, value of shipment and specific product data is the Census of Manufactures. In the case of the fruit and vegetable canning and freezing industry, an additional source was also available, The Directory of the Canning, Freezing, Preserving Industries published by Edward E. Judge and Sons, Inc. The Directory contains data concerning plant location, volume, specific products, and type of plant and is the Directory generally recognized by industry. Both sources were utilized throughout the report.

The problem is that these data sources are not in perfect correspondence. For example, the following summary depicts the number of fruit and vegetable canning and freezing plants contained in the two references. Projections of number of plants based on the two sources is also presented in Table II-1.

Table II-1. Numbers of fruit and vegetable canning and freezing plants in the United States

	Number of Plants								
	1947	1954	1958	1963	1967	1970	1972	1975	1980
From Census of Manufacturers									
Canners	2,265	1,758	1,607	1,430	1,223	1,165		1,990	800
Freezers	291	266	426	650	608	580		545	505
Total	2,556	2,024	2,033	3,080	1,831	1,745	--	1,445	1,305
From Judge's Directory									
Canners	--	--	--	--	--	841	828	715	578
Freezers	--	--	--	--	--	176	185	165	153
Combination	--	--	--	--	--	171	181	145	117
						1,188	1.205	1,025	848

The above summary shows a total discrepancy of 537 plants (1,745 - 1,188) in the 1970 data. The lack of 1972 census data prevented comparing current plant numbers from the two sources.

There are several possible explanations for this data reporting discrepancy; however, one factor explains most of the differences. The singularily most important factor is believed to stem from the fact that census data includes all plants, including the extremely small plants employing only one employee, while many of these plants may have been deleted from Judge's directory. While there is no way to completely reconcile the two data sources given time and budget considerations, a few brief explorations were employed to explain the discrepancy.

A comparison of Judge's plant listings by number of plants by state with the number of plants by state with 20 employees or more as reported by Census eliminates much of the data discrepancy and suggests that some of the small plants have been deleted from Judge's directory. An additional comparison between number of plants by employment according to Judge again reveals that the greatest disparity exists in the number of small processing plants as reported in the two sources. This again would seem to indicate that the difference can in large part be explained by the omission of some very small plants from Judge's directory.

In view of the fact that the Directory contains current data on number of plants, location of plants and specific products that cannot be acquired from Census, Judge's directory was utilized. The qcquisition of other data, i.e., value of output, concentration ratios and other data, was taken from census publications.

While the data discrepancies cannot be reconciled and as such presents a few difficulties, they had to be used. Number of firms and employment estimates from the two sources are presented in a later section.

II. INDUSTRY SEGMENTS

A listing of fruit and vegetable canning and freezing plants compiled from Judge's Directory contains a total of 1,205 commercial establishments. An additional 178 fruit and vegetable dehydrating plants are reported in the Census of Manufactures which brings the total number of plants to be considered to 1,383. The number is great enough and the products, technology and firm types so diverse that this study required the detailed segmentation of the industry before it could consider the economic impacts of pollution controls on "typical" industry segments.

The objective of this section of the study is to present various characteristics of the fruit and vegetable canning, freezing, and dehydrating industries. The first major section is devoted to firm and industry characteristics; later sections discuss specific plant and product characteristics.

A. Characteristics of Fruit and Vegetable Canning, Freezing, and Dehydrating Firms

Fruit and vegetable canning, freezing, and dehydrating firms vary greatly in size, organizational structure, product mix, and degree of diversification and integration. The firm and industry characteristics considered in this section include number and size of firms, degree of integration, concentration, employment and payroll.

1. Size and Number of Firms

a. Canners

A detailed analysis was made of the case-pack volume for 598 canners. This analysis emphasized physical volume rather than gross sales. To avoid any possible disclosure of individual operations, only industry totals for seven volume categories were considered. Table II-1 indicates the number of firms in each volume category.

Table II-1. Size distribution, fruit and vegetable canning firms, 1970

Size Category	Number of Firms	Percent of Total
(Annual volume cases canned product)		
Under 100,000	106	17.6
100,000 - 250,000	108	18.1
250,000 - 500,000	114	19.1
500,000 - 1,000,000	99	16.6
1,000,000 - 2,000,000	66	11.0
2,000,000 - 5,000,000	44	7.4
Over 5,000,000	61	10.2
	598	100.0

Source: The Directory of the Canning, Freezing and Preserving Industries, 1970-71.

Over a third of the firms analyzed (35.7%) would be considered small canners with an annual pack of less than 250,000 cases; 28.6 percent packed over 1,000,000 cases and would be classed as large; 10 percent of the canners packed over 5 million cases annually and would be considered in the very large group.

During the intervening time period (1970-1973) several industry trends continued, i.e., closure of small firms and increased dominance and number of larger, multiplant firms. It is not possible at this time to present a table comparable to Table II-1 for 1973; however, several preliminary observations are appropriate. For example, Judge's Directory reveals a net decrease of 49 (134 deleted and 85 new) fruit and vegetable canning plants from the industry listing. This includes 134 plants that may have discontinued operations as a result of unfavorable profit positions or other reasons and 85 new plants that have entered the industry. Some of the 134 deleted plants may have merely merged with other firms or changed ownership and/or mailing addresses. Some of the plants included as "new" plants may represent previously existing plants that have been added to the Directory for the first time. Since, however, the trends are consistent with a priori industry information, there is merit in including preliminary and qualified results or observations.

An analysis of the specific characteristics of the deleted plants revealed that 80 percent of these plants were small processing plants and 6 percent were large processing plants, e.g., less than 500,000 annual cases and over 5,000,000 annual cases respectively.

On the other hand, if the emphasis is on firms as opposed to plants, the listings of new and deleted firms revealed that a disproportionally large number of the deleted plants were single firm plants. The listing of new plants reveals that most are affiliated with multi-plant firms.

These results indicate that when Table II-1 is updated to reflect the number of firms by annual volume, an increase in the number and importance of medium and large firms will be reflected.

b. Freezers

Volume data were available from 231 fruit and vegetable freezing firms. The size distribution of these firms is shown in Table II-2.

Table II-2. Size distribution, fruit and vegetable freezing firms, 1970

Size Category	Number of Firms	Percent of Total
(Annual volume million lbs.)		
Under 2	43	15.8
2 - 5	41	15.1
5 - 10	30	11.1
10 - 20	31	11.4
20 - 50	37	13.7
50 - 100	27	10.0
Over 100	62	22.9

Source: The Directory of the Canning, Freezing and Preserving Industries, 1970-71.

Approximately 30 percent of all firms analyzed are small freezers, with annual volume of less than 5 million pounds; 46.6 percent are large (annual volume in excess of 20 million pounds); 22.9 percent are very large with annual packs in excess of 100 million pounds.

Procedures similar to the above were employed to ascertain recent trends in the number of fruit and vegetable freezing firms. The results of these investigations reveal that, based solely on number of plants the freezing segment of the industry is in a better relative position in that the change in number of plants indicates an increase rather than a decrease as was the case for fruit and vegetable canners. Twenty-four freezers were deleted from while thirty-six freezers were added to the Directory from 1970-1973, a net increase of twelve freezing plants. Delineating the net addition by size produced inconclusive results with no perceptible trends in number of plants by size classification.

Segmenting the new and deleted plants by type of firm reveals that approximately 83 percent of the deleted plants are single plant firms while 50 percent of the new firms are affiliated with single plant firms. On the other hand, only 4 percent of the deleted plants were associated with firms consisting of 2 to 5 plants while 44 percent of the new plants were associated with firms consisting of 2 to 5 plants. Since the single plant firms are characteristically small producers and the multiplant firms tend to produce a larger combined total output, the results are similar to those previously observed in the canning segment of the industry, i.e., a shift in the number and importance of firms in the middle and upper size categories.

c. Dehydrators

A comparable series, i.e., number of firms by annual volume pack, does not exist at the present time for the dried and dehydrated fruit and vegetable processors. One, and, perhaps, the only alternative is to present the number of food dehydrators by employment class. These data are available for 1967 from the Census of Manufactures and are summarized below in Table II-3. Census data concerning the number of canned and frozen fruit and vegetable processors by employment size are also presented in this table so as to provide insight and perspective into the relative importance of the three industry segments.

2. Degree of Integration

The fruit and vegetable canning, freezing and dehydrating industries show little vertical integration. Based on the special canner survey of the Economic Research Service, U. S. Department of Agriculture in 1964 estimated that only 8 percent of the fruits and vegetables canned were obtained from land owned or rented by canners. A comparable situation existed in the freezing industry where only 9 percent of the raw product was obtained from freezer-owned or rented land.

Table II-3. Size of fruit and vegetable processing establishments, by number of employees, census years 1954-67.

Year	Establishments with: 1-4 employees	5-19 employees	20-99 employees	100-499 employees	500 or more employees	Total
	Number					
Canners:						
1954	377	383	715	254	29	1,758
1958	285	409	627	266	20	1,607
1963	276	318	547	266	23	1,430
1967	281	210	433	273	26	1,223
Freezers:						
1954	41	57	104	59	5	266
1958	51	112	138	111	14	426
1963	139	165	194	136	16	650
1967	135	110	186	147	29	607
Dehydrators:						
1954	45	39	42	22	0	148
1958	49	45	41	26	0	161
1963	42	54	57	23	0	176
1967	51	46	46	35	0	178

Source: Bureau of the Census, Census of Manufactures, U.S. Department of Commerce.

canners. A comparable situation existed in the freezing industry where only 9 percent of the raw product was obtained from freezer-owned or rented land.

Over two-thirds of the supply of fruits and vegetables processed by canners and freezers is obtained through contractual arrangements with growers. Contracting with growers has provided a means whereby canners and freezers can reduce the risk of raw product supply variations from year to year without investing capital resources directly into farm production; thus, they avoid the necessity of integrating backward into production.

Canners and freezers also have never integrated very far forward into wholesale and retail trade. Some large processors do maintain sales offices in principal wholesale markets, however, brokers handle over two-thirds of the sales of processed fruits and vegetables. A comparable situation is believed to exist for the dried and dehydrated food processing industry especially in the dehydrated potato industry which also makes extensive use of contractural grower processor arrangements.

3. Industry Diversification and Specialization

While most canners and freezers operate multiple-product plants and process a diversified line of fruits, vegetables and juices, these industries are nevertheless highly specialized in the processing of fruits and vegetables. A part of this specialization is location-oriented in that plants are located in centers of fruit and vegetable production; another part is equipment-oriented since specialized equipment is required.

The Bureau of the Census calculates specialization ratios for different types of industries. These represent the ratio of sales value of all the primary products of the plant to its total of primary plus secondary products.

a. Canners

In 1967, the specialization ratio for fruit and vegetable canning plants was calculated to be 90 percent. This indicates that canned fruits, vegetables and juices represented 90 percent of the value of gross sales of these plants. Secondary products shipped by this industry consist mainly of canned food specialty products and frozen fruits and vegetables.

b. Freezers

This industry's production of frozen fruits and vegetables (primary products) in 1967 represented 92 percent (specialization ratio) of its total product shipments. Secondary products consisted mainly of canned fruits and vegetables and dehydrated food products.

c. Dehydrators

In 1967 the specialization ratio for fruit and vegetable dried and dehydrating plants was calculated to be 94 percent. The secondary products shipped consist mainly of canned and/or frozen food products.

Post-1967 specialization ratios for the three industry segments are not available.

4. Concentration of Fruit and Vegetable Firms

Local area processing concentration has little meaning to the fruit and vegetable canning, freezing and dehydrating industries. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions, therefore, concentration by value of shipments is an important consideration.

a. Canners and Freezers

The canning and freezing industry is characterized by a large number of firms; small farms share a very small segment of the total market and have very little influence on industry prices and total supply. In addition, concentration is much higher on a product than a firm basis. Table II-4 presents canning and freezing concentration ratios which show that the four largest companies account for 21 and 26 percent of the value of shipments for canners and freezers, respectively. Table II-4 also presents the concentration ratios for 1963 and 1967.

b. Dehydrators

The fruit and vegetable dehydrating industry is much smaller in size (measured by volume of annual sales) and also has a greater degree of concentration, i.e., concentration by firm domination as well as area concentration.

Table II-4. Percent of value of shipments accounted for by largest companies in each industry segment

SIC Code/year	Value of Industry Shipments				
	Total (Million dollars)	Percent Accounted For By			
		4 largest companies	8 largest companies	20 largest companies	50 largest companies
2033 (Canning)					
1970	NA	21	33	NA	NA
1967	930	22	34	52	70
1963	1,135	24	34	NA	66
2034 (Dehydrated)					
1970	NA	33	52	NA	NA
1967	134	32	50	75	96
1963	126	37	56	80	NA
2033 (Frozen)					
1970	NA	26	NA	NA	NA
1967	495	24	36	55	74
1963	566	24	37	54	70

Source: Bureau of the Census, Census of Manufacturers, U. S. Department of Commerce.

Table II-4 presents the total value of shipments and the percent accounted for by the 4 largest, 8 largest, 20 largest and 50 largest companies for the three industry segments. As stated above, the number of firms is smaller and the concentration is greatest in the dehydrating segments of the industry. While there is considerable concentration by a few firms, the remainder of the production is contributed by numerous small firms.

Table II-4 also shows that for the years 1963 to 1970, there is some evidence of increased importance of the larger firms within the fruit and vegetable frozen food industry as the concentration ratio has increased from 24 percent in 1963 to 26 percent in 1970. The reverse is true for the canned and dehydrated segments of the industry in that the percent accounted for by the four largest firms has declined slightly.

These trends seem to be somewhat inconsistent with the increasing number of multiplant firms observed earlier. This, however, may not be the case, for the concentration ratios have been presented for the 4, 5, 20, and 50 largest firms only. This represents only a small portion of the total firms in both the canning and freezing industry. The decline of small plants and the increased number of multiplant firms observed earlier reflected all firms, even the extremely small, which may explain the discrepancy in the observed trends.

5. Total Employment in the Industry

The fruit and vegetable canning, freezing and dehydrating industries are major employers of labor in the areas in which they operate. Further, they employ a high proportion of low-skilled, seasonal workers in relation to total employment in the industry. As a result, curtailment of these processing industries would have an important impact on employment in the lower income levels in the areas concerned.

a. Number of Employees

Canning Industry - The total employment in the fruit and vegetable canning plants in 1970 was 96,400 down from 100,000 in 1967 and 108,400 in 1957. A large percentage (89 percent) of all employees were production workers (1967). Only sixty percent of the plants employed more than 20 people in 1967 compared with 57 percent in 1958. This segment is by far the most important of the three industry segments considered with 54 percent of the total employment in all three industry segments combined.

Freezing Industry - In contrastt othe canning industry where total employment has decreased, employment in the fruit and vegetable freezingi ndustry increased from 39,500 in 1958 to 64,500 in 1967 and to 71,800 in 1970. This represents a gain of 63 percent from 1958 to 1967 and an increase of 11 percent from 1967 to 1970. Average number of employees per plant increased from 93 in 1958 to 106 in 1967, again reflecting increases in the scale of operations. Production workers in 1967 represented 91 percent of total employment, up 3 percent over 1958. Sixty percent of the plants employed 20 or more people. The freezing industry employs 40 percent of the total employment of the combined three industry segments.

Dehydrating Industry - The dehydrating industry (much smaller in terms of total employment) employed a total of 11,000 employees in 1967 and 10,700 in 1970. Eighty-four percent of the 1967 employees were production workers. This represents approximately 6 percent of the total employment in the combined industry segments.

b. Industry Payrolls

Canning Industry - The 1967, annual payroll in the canning industry totaled $473,800,000, an average of $387,000 per plant; in 1970 the total payroll was $523.800,000. Production payrolls equalled 79 percent of total payroll in 1967. The average annual earnings per employee was $4,732 in 1967.

Freezing Industry - The annual payroll in the fruit and vegetable industry in 1967 was $295,200,000 and $389,900,000 in 1970. Production payrolls equalled 78 percent of total payroll in 1967. Average annual earnings per employee was $4,576 in 1967.

Dehydrating Industry - Total payroll for the dehydrating industry was $58,000,000 in 1967 and $68,700,000 in 1970. Production workers claimed 75 percent of the 1967 payroll.

B. Number of Plants and Employees in Each Segment

One aspect of the discussion that is of obvious importance is the number of plants and employees in each industry segment. This information is summarized below. The detail of these estimates is presented more fully in subsequent sections. For this reason the summary is tabulated without further supporting explanations.

Table II-4a. Number of plants and employees by industry segment

	Number of Plants	Estimated Number of Employees
SIC 1/		
2033 (Canning)	1,223	100,100
2034 (Dried & Dehydrated)	178	11,100
2037 (Freezing)	607	64,300
Specific Products 2/		
Apples	144	14,655
Citrus	105	10,602
Asparagus	60	7,305
Spinach	52	7,165
Potatoes	103	13,250

1/ Number of plants and employees by SIC from 1967 Census of Manufactures

2/ Number of plants from The Directory of the Canning, Freezing and Preserving Industries, 1972-73.

Employment estimates are based on an average employment of 55, 90, and 190 for small, medium and large plants respectively. These employment estimates have been suggested by personnel closely associated with the canning and freezing industries. It is believed, however, that these average employment estimates are somewhat low for citrus and potato plants.

C. Characteristics of Fruit and Vegetable Canning, Freezing and Dehydrating Plants

Because closure decisions are frequently made on a plant-by-plant basis, a more convenient, readily available, and in some cases, a more meaningful industry profile is derived by segmenting the industry by plant characteristics rather than by firm characteristics. Within multiplant firms, some plants may share a disproportionately large share of the total burden of mandatory pollution abatement standards and, consequently, may discontinue operations while perhaps newer, more effluent and profitable plants will be virtually unaffected.

A variety of plant characteristics including but not limited to size, location, number, utilization and efficiency are presented in the ensuring discussion.

1. Number and Location of Plants

A summary of the recently published industry Directory indicates that the 1,205 fruit and vegetable canning and freezing plants in the U. S. include 828 fruit and vegetable canners, 196 fruit and vegetable freezers and 181 plants that can and freeze fruit and/or vegetables. Table II-5 presents the total number of fruit and vegetable canners, freezers and combination plants in the U. S. by economic region.

Table II-5 shows that all thirteen economic regions within the contiguous 48 states contain fruit and vegetable canning plants with 473 or 57 percent located in four economic regions -- Atlantic, Upper Great Lakes, North Central and the Pacific Southwest region. All regions with the exception of the South Center and Southwest Plains Region also contain fruit and vegetable freezing plants. One hundred thirty-four or 68 percent of all fruit and vegetable freezing plants are located in the Pacific Northwest, Pacific Southwest, Atlantic and Gulf Coast and Eastern Great Lakes Regions. There are combination plants, i.e., canners and freezers in all regions with the exception of region six -- Central Plains Region. Four regions, i.e., Eastern Great Lakes, Lower Great Lakes, Atlantic and Gulf Coast and the Pacific Northwest Regions, contain 61 percent of all combination plants.

Table II-5. Number of canning, freezing and combination plants by economic region (1972) [1]

Type of Plant	Economic Region [2]														Percent of all plants
	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	
Canner	132	69	56	101	107	14	47	38	52	16	24	39	133	828	69
Freezer	15	23	17	2	5	1	9	5	22	0	8	55	34	196	16
Both	20	21	33	9	4	--	5	3	21	3	8	35	19	181	15
Total	167	113	106	112	116	15	61	46	95	19	40	129	186	1,205	100
Percent of total	14	9	9	9	10	1	5	4	8	2	3	11	15		100

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[1] Source: The Directoryof the Canning, Freezing and Preserving Industries, 1972-73, Edward E. Judge & Sons Winchester, Maryland

[2] Economic Regions of the U.S.:

1. Atlantic Region
2. Eastern Great Lakes Region
3. Lower Great Lakes Region
4. Upper Great Lakes Region
5. North Center Region
6. Central Plains Region
7. Central and Eastern Upland Region
8. Southeast Coastal Plains Region
9. Atlantic and Gulf Coast Region
10. South Center and Southwest Plains Region
11. Rocky Mountain Region
12. Pacific Northwest Region
13. Pacific Southwest Region

The number of fruit and vegetable dehydrating plants by census region is presented in Table II-6 which shows that fruit and vegetable dehydrating plants are concentrated primarily in the western producing regions -- 76 percent of all dehydrating plants are localed in the West Census Region. This is explained by the importance of potatoes, raisins and prunes as major dehydrated commodities.

Table II-6. Number of fruit and vegetable dehydrating plants by Census region (1967)

Census Region	Number of Plants	Percent of Total
Northeast Region	20	11
North Central Region	15	8
South Region	7	4
West Region	136	76
Total U.S.	178	100

Source: Bureau of Census, Census of Manufactures, U.S. Dept. of Commerce

2. Size of Plant

Segmenting the fruit and vegetable canning and freezing plants by volume of annual pack illustrates the dominance of small plants in these segments of the industry. A similar segmentation for combination plants shows that approximately 79 or 44 percent of all combination plants are classified as medium sized plants.

Table II-7 shows the number and percent of fruit and vegetable canning and freezing plants by volume of annual pack.

A listing of fruit and vegetable dehydrating plants by size classification can not be expanded beyond that presented in Table II-3.

Table II-7. Number and percent of canning and freezing plants by volume of annual pack

Type of Plant	Size Classification	Number of Plants	Percent of total
Canners	Small (up to 500,000 annual cases)	390	47
	Medium (500,000 to 5 million annual cases)	203	25
	Large (Over 5 million annual cases)	235	28
Total		828	100
Freezers	Small (up to 10 million pounds)	82	42
	Medium (10 to 100 million pounds)	73	37
	Large (over 100 million pounds)	41	21
Total		196	100
Combination Plants (Canners and Freezers)	Small	58	32
	Medium	79	44
	Large	44	24
Total		181	100

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-1973.

3. Single Plants vs. Multiplants

All 1,205 canning, freezing and combination plants were classified on a single plant or multiplant firm basis to produce the distributions presented in Table II-8.

The dominance of single plant firms is again obvious: more than 50 percent of all plants--canners, freezers or combination plants--are single plant firms.

The absence of a comprehensive listing of all fruit and vegetable dehydrating plants necessitates confining the above discussion to fruit and vegetable canners and freezers only.

4. Number of Plants by Type of Product

An additional segmentation, i.e., type of plant by type of product, reveals that approximately 55 percent of all canners process only vegetables, 21 percent only fruit, and 24 percent both fruit and vegetables. The distribution of the number and percent of freezer and combination plants by type of product is presented in Table II-9. A relatively large percentage of freezers process fruit only, while the percentage of plants processing both fruits and vegetables is relatively constant by type of plant.

Table II-8. Number of plants per firm

	Total Number and Percent of Plants Belonging to:						
	Single Plant Firms		Few Plants per Firm (2-5)		Many Plants per Firm (6 and over)		
Type of Plant	No.	Percent	No.	Percent	No.	Percent	Total
Canner	457	55	189	23	182	22	828
Freezer	109	56	66	34	27	14	196
Combination	96	53	63	35	22	12	181
Total							1,205

Source: The Directoryof the Canning, Freezing and Preserving Industries, 1972-1973.

Table II- 9. Type of plant by type of product

	Total Number of Plants and Percent by Type of Product					
Type of Plant	Number Vegetable Only	Percent by Type	Number Fruit Only	Percent by Type	Number Both Fruit & Vegetable	Percent by Type
Canner	451	54	176	21	201	24
Freezer	77	39	80	41	39	20
Both	53	29	85	47	43	24

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-1973.

5. Number of Products by Type of Plant

Approximately 70 percent of all canning, freezing and combination plants are multiproduct plants. The distribution of type of plant by number of products packed is presented in Table II-10. This table is again concerned with only canning, freezing or combination plants. Data are not available for fruit and vegetable dehydrating plants.

The advantages to be gained by processing several products include increasing the length of the processing season due to different harvest dates by type of crop, the avoidance of crop failure effects, the disadvantage of adverse price and demand fluctuations associated with a single product, and a greater utilization of plant capacity.

6. Age of Plants and Level of Technology

The level of technology is difficult to assess in the fruit and vegetable industry. Many of the plants are relatively old, but throughout their useful life, new equipment has been added or has replaced old or technologically obsolete equipment. As a result, most plants in the industry are a combination of old and new equipment. Generally, the newer equipment installed represents a higher level of technology than the old.

Recently the National Canners Association surveyed the age of plants. 1/ Approximately 200 plants were surveyed and the approximate years-at-the-site is given in Table II-11 along with the years since the expansion (Table II-12 also contains Seafood and Specialty plants). Only 13 percent of the plants were less than 10 years of age and 8 percent from 10-19 years. Seventy-nine percent of the plants were located at the same sight for more than 20 years. Sixty-two percent of the plants have undergone a major expansion program in the last five years, however, and another 19 percent had undergone expansion moves since 1960. Nineteen percent had not expanded since 1959 or earlier.

Most plants surveyed in the New England, North Central and Mountain Regions were over 40 years old. By commodity the oldest plants spread throughout the three classifications of fruit, tomato and vegetable canning plants. By comparison the Seafood and Specialty plants were relatively newer.

1/ National Canners Association.

Table II-10. Number of products by type of plant

Type of Plant	Number and Percent of Plants by Type and Number of Products						
	Number of Single Product Plant	Percent by Type	Number of Few Product Plants (2-5)	Percent by Type	Number of Many Product Plants (6 and over)	Percent by Type	Total
Canners	289	35	483	58	56	7	828
Freezers	67	35	112	57	17	9	196
Combination	60	33	116	31	5	3	181
Total	416		711		78		1,205

Table II-11. Percent of Canning Plants in Various Age Groupings by Location and Commodity and Years Since Last Major Expansion

	Location									
Years at site	New England	Middle Atlantic	South Atlantic	North Central	South Central	Mountain	North-west	Alaska	South-west	Total
0 - 9	8	9	9	9	16	0	17	30	14	13
10 - 19	8	9	12	5	5	0	11	10	9	8
20 - 39	8	34	49	16	53	27	49	25	34	33
40 - 59	53	34	21	50	21	46	18	10	37	33
60+	23	14	9	20	5	27	5	25	6	13
Total	100	100	100	100	100	100	100	100	100	100
Years since last expansion										
65 - 69	46	55	64	62	68	50	63	85	60	62
60 - 64	8	25	12	22	5	20	21	5	20	19
50 - 59	8	8	18	11	16	10	9	10	12	11
Before '50	38	12	6	5	11	20	7	0	8	8
Total	100	100	100	100	100	100	100	100	100	100

	Type				
Years at site	Fruit	Tomato	Vegetable	Seafood	Specialty
0 - 9	9	9	10	17	14
10 - 19	8	0	7	15	13
20 - 39	40	30	32	26	30
40 - 59	34	45	40	23	30
60+	9	16	11	19	13
Total	100	100	100	100	100
Year since last expansion					
65 - 69	53	61	64	63	67
60 - 64	23	17	22	7	16
59 - 59	14	15	7	15	10
50-	10	7	7	15	7
Total	100	100	100	100	100

To arrive at some level of efficiency for plants in various age categories, (assumed to reflect the level of technology) the Department of Interior report The Cost of Clean Water, Volume II, No. 6, [1] was used. The capital costs and annual operating and maintenance costs were estimated for old (1950), prevalent (1963) and new (1967) plants. These estimates were converted to an index of investment and operating costs for selected plants (Table II-12).

The above procedure can be utilized for fruit and vegetable canning and freezing plants. Comparable procedures will have to be developed if dehydrating plants are included.

7. Plant Efficiency

Plant efficiency, an even broader concept, includes many factors among which are age, level of technology, utilization, and capacity. Obviously, these factors cannot be discussed on a firm or plant-by-plant basis. Only a few passing comments and a general summary are given here.

"Capacity" is defined as the output which a canning or freezing plant is capable of producing during a given time under specified conditions. "Normal" capacity is the output per unit of time which can be realized under usual operating conditions. "Maximum" capacity is the greatest output obtainable, per unit of time, with existing plants and equipment. "Excess" capacity equals capacity minus volume processed through a plant during a given time period.

Utilization of capacity is the degree to which bormal capacity is attained in the output of a plant during a given period. It is an important factor in the financial success of a given plant and is affected by a number of supply, operating and sales factors (summarized in Table II-13).

Little information is available concerning capacity and utilization of capacity in canning and freezing plants. The only authoritative study in this area was done in the Southern Region. [2] Pearson found that canning plants in the South utilized only 57 percent of their vegetable processing capacity against 74 percent for freezers. As a general rule, the plants largest in size utilized a greater portion of their capacity.

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[1] The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, FWPCA, U.S. Dept. of Interior, 1967.

[2] Pearson, James L., "Utilization of the South's Vegetable Processing Capacity, Department of Agr. Econ., Fla. Agr. Exp. Sta. and Econ. Res. Sv., USDA, Ag Econ. Res. Rpt. EC68-5, January 1968.

Table II - 12. Index of Investment and Operating Costs for Old, Prevalent, and New Technology by Size of Plant

	Small Plant 2,000 cases/day		Medium Plant 10,000 cases/day		Large Plant 30,000 cases/day	
	Capital Cost	Annual O&M	Capital Cost	Annual O&M	Capital Cost	Annual O&M
Old Technology (1950)	62	107	62	115	58	114
Prevalent Technology (1963)	80	100	85	107	83	108
New Technology (1967)	100	100	100	100	100	100

Source: Adapted from The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, FWPCA, U. S. Dept. of Interior, 1967.

Table II-13. Summary of factors affecting utilization of capacity within fruit and vegetable processing plants

Factor	Comments
1. Length of Harvest Season by Product	Year to year variation exists
2. Distribution of Raw Product Supplies Within Harvest Season	Varies from year to year, but generally peaks within season. Delays occur from lack of availability
3. Sales demand	Year to year variation affects planned pack
4. Raw Product Quality/Recovery Percentage	Percent of raw product recovered varies product quality
5. Level of Maturity of Raw Product	Can vary within a season and affects quality
6. Degree of Additives to the Raw Product	May alter normal utilization in terms of raw product processed.
7. Productivity of Labor/Job Performance	Varies somewhat and effects utilization of plant capacity
8. Number of Products & Schedule	Multiproduct plants may have overlapping and competing seasons. Capacity is affected by definition.
9. Variations in container Sizes	Affects raw product volume capacity
10. Warehouse and Inventory Conditions	Plant schedules may vary with associated warehouse space and/or inventory conditions

Since there is substantial year-to-year variation in the production of fruits and vegetables, 10-20 percent excess capacity, above nornal, is desirable to enable the industry to process the production of larger-than-normal years.

It was estimated that by increasing processing line rates per hour and by extending hours worked or by adding shifts, canning plants could increase their capacity above "normal" levels by 25 percent or more.

Obviously, then, considerable excess capacity exists in both the canning and freezing industries. In general, utilization of capacity is higher in larger plants and in intensive, commercial production areas. It is also recobnized that there are other factors that must be considered. These, however, will be deferred to a later time and section. It is worthwhile to mention that most of these relevant factors will have to be explored at the industry level, for time and effort constraints and, more importantly, data availability prevent discussing these factors on a plant level.

D. Characteristics of Specific Product Segments of the Industry

As previously mentioned, the emphasis of this report focuses on five specific products or product types within the fruit and vegetable canning, freezing and dehydrating industry. These include the processing of apples, asparagus, spinach, potatoes and citrus. As was demonstrated, a delineation by specific products encounters several difficulties, i.e., most fruit processors deal with a variety of products including many other fruits and other vegetables. Vegetable processors seldom produce a single vegetable product and when they do, it is likely to be a major vegetable such as peas, beans, or corn processed in numerous varieties and types.

There is, therefore, the obvious need to further segment the industry to ascertain the specific characteristics of plants processing the above mentioned products.

1. Citrus

The characteristics of the citrus processing industry are developed below to provide insight into the salient characteristic of this industry segment. The discussion includes products packed by volume and location, size of citrus plants, employment, and other specific plant characteristics.

a. Citrus Products and Pack Volumes

Citrus products include the following specific products:

Citrus Sections
1. Grapefruit sections
2. Orange sections
3. Citrus salad

Citrus Drinks
1. Lemonade concentrate
2. Orange
3. Pineapple-grapefruit
4. Pineapple-orange

Citrus Juices
1. Single strength grapefruit
2. Grapefruit concentrate
3. Grapefruit-orange
4. Lemon
5. Lime
6. Single strength orange
7. Orange concentrate
8. Tangerine

The volume packed by production area for selected citrus products is shown in Table II-14 through Table II-18.

b. Citrus Processing Plant Characteristics

A detailed analysis of the 1972-73 Judge's Directory indicates that 105 plants process citrus products and 103 citrus processing firms are engaged. A further breakdown of plants by specific product shows that only 41 of the 105 plants process only citrus products. The remainder (64) process other fruits or vegetables in addition to citrus products. The typical citrus plant is, therefore, a multiproduct plant, multiproduct across other product lines.

Even within the group of citrus plants that deal exclusively with citrus products, there is a variety of specific citrus product mixes or combinations. The following distribution (Table II-19) of exclusively citrus producing plants by specific citrus product shows that the largest number is engaged in the processing of citrus juices.

Table II-14. U.S. pack of canned grapefruit segments by state
(Thousands of actual cases -- pack beginning year shown)

State	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970*
Florida	4,610	2,985	3,394	4,077	4,413	5,239	3,772	3,800	3,726	3,629
Texas	11	--	--	--	--	--	--	--	--	--
U.S. Total	4,621	2,985	3,394	4,077	4,413	5,239	3,772	3,800	3,726	3,629

*1971-72 pack to 4/29/72 Florida only, basis 24/2's - 2,562,792 cases as reported by Florida

Source: Division of Statistics, National Canners Association

Table II-15. U.S. packs of canned orange juice by states
(Thousands of actual cases -- pack beginning year shown)

State	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970*
Florida	15,423	12,772	10,157	13,027	13,466	15,803	11,895	13,702	14,266	13,368
Texas	723	--	--	--	NA	519	305	878	(a)	1,776
California & Arizona	NA	595	482	469	679	1,308	352	1,111	2,816	1,822
U.S. Total	16,146	13,367	10,639	13,496	14,145	17,629	12,551	15,691	17,082	16,966

*1971-72 pack to 4/29/73 Florida only basis 24/2's - 9,660,217. Cases as reported by the Florida Canners Association
(a) Included in California and Arizona
Source: Division of Statistics, National Canners Association

Table II-16. U.S. packs of canned grapefruit juice
(Thousands of actual cases -- pack beginning year shown)

State	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970*
Florida	8,907	7,829	4,665	8,721	10,671	15,565	11,756	12,586	14,711	17,393
Texas	355	--	--	--	658	1,579	684	2,681	(a)	4,174
California & Arizona	549	551	997	1,020	886	1,233	1,622	1,940	5,369	2,287
U.S. Total	9,811	8,380	5,662	9,741	12,215	18,377	14,063	17,207	20,080	23,854

*1971-72 pack to 4/29/72 Florida only, basis 24/2's 19,224,837 cases as reported by the Florida Canners Association
(a) Includes California and Arizona
Source: Division of Statistics, National Canners Association

Table II-17. U.S. packs of canned blended grapefruit and orange juice by state
(Thousands of actual cases -- pack beginning year shown)

State	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Florida	3,248	2,622	2,006	2,019	2,203	2,705	1,689	1,908	1,799	1,791
Texas	39	--	--	NA	NA	44	28	56	(a)	93
California & Arizona	NA	13	128	65	180	303	92	176	186	161
U.S. Total	3,288	2,635	2,135	2,084	2,384	3,053	1,809	2,141	1,984	2,046

*1971-72 Pack to 4/29/72 Florida only, basis 24/2's - 1,655,588 cases as reported by Florida Canners Association

(a) Included in California and Arizona

Source: Division of Statistics, National Canners Association

Table II-18. U. S. packs of frozen citrus juices
(thousands of gallons)

	Year							
	1964	1965	1966	1967	1968	1969	1970	1971
Concentrated Citrus Juices								
Orange	53,674	88,869	70,831	127,611	83,697	108,043	126,402	125,187
Grapefruit	2,573	4,000	3,971	5,485	1,814	5,920	4,294	6,870
Grapefruit-Orange	130	70	50	29	10	36	16	18
Lemon	NA	NA	NA	NA	NA	NA	NA	NA
Lemonade	NA	NA	NA	NA	NA	NA	NA	NA
Limeade	1,196	862	795	503	541	852	1,345	1,648
Tangerine	1,146	1,154	715	1,120	582	1,051	785	1,090
Citrus Juices, Single Strgth & Purees	1,576	1,188	1,470	NA	NA	NA	NA	NA

Source: THE ALMANAC of the Canning, Freezing, Preserving Industries, for 1972.

Table II-19. Breakdown of 41 exclusively citrus producing plants by type of product produced

Citrus Product	Number of Plants
Sections only	1
Drinks only	3
Juices only	18
Sections and juices	7
Drinks and juices	8
Sections, drinks, and juices	4

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-73.

Table II-20 provides a breakdown of the specific plant characteristics for all 105 citrus producing plants. Factors considered include number of plants by type of product, type of plant, size of plant and number of products.

Table II-20. Number of plants by specific characteristics

	Type of Product	
Citrus Only	Fruit Only	Fruits and Vegetables
41	70	35
	Type of Plant	
Canners Only	Freezer Only	Both
68	17	20
	Size of Plant	
Small	Medium	Large
36	43	26
(Under 500 thousand canned cases; under 10 million frozen pounds)	(500 thousand to 5 million cases; 10 million to 100 million frozen pounds)	(Over 5 million cases for canners; over 100 million pounds for freezers)
	Number of Products	
Single	Few	Many
(Citrus only)	(2 to 5 products--citrus and other than citrus)	(6 and over, products--citrus and other than citrus)
41	39	25

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-73.

Table II-20 reveals that only 39 percent of all citrus producing plants process only citrus products, 67 percent process only fruit (citrus and other fruit products) while 33 percent of the plants process fruits and vegetables. Sixty-five percent are canners, 16 percent are freezers, and 19 percent are combination freezer-canner plants. Approximately one-third are classified as small, 40 percent are medium and 25 percent are large plants on the basis of annual pack volumes. Approximately 60 percent of the plants are multiproduct plants. On the basis of the above percentages only, it appears that the typical citrus plant is a small to medium sized canner that processes many citrus and other fruit products.

Employment statistics by plant by specific product cannot be obtained from government sources at the present time. An alternative is to estimate employment based on average employees by size of plant (volume pack). The following data were derived from a report by the National Canners' Association, [1] for the entire industry. This provided a general basis for developing employment estimates for the industry segments in this study:

Item	"Small"	"Medium"	"Large"	"Extra-Large"
Plant Size (1,000 Tons Raw Product)	.5-5	10-20	50-100	200-500
Number of Plants	1,450	500	170	30
Employees				
Peak Period				
. Estimate [2]	105	380	1,035	2,600
. Range	42-170	300-500	850-1300	1900-4000
Average per Month				
. Estimate [2]	55	145	400	870
. Range	20-85	120-180	330-500	750-1100

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[1] "Liquid Wastes and The Economic Impacts of Pollution Control; Fruit and Vegetable Processing Industry," Progress Report, National Canners Association, July 1973.

[2] Weighted average of employees by size category. Weighted by number of plants in NCA report.

As indicated, a wide range of plant sizes and associated employment levels exist in the fruit and vegetable processing industry as a whole. Ideally, account should be taken of the specific products involved and the labor requirements on a product by product basis. However, in lieu of more precise information, the procedure for indicating general employment levels of plants in this study was to multiply numbers of plants by "size" times the average monthly employment estimates above, i.e.,

Small plants	-	55 employees
Medium plants	-	145 employees
Large plants	-	400 employees

The estimates for "Extra-Large" plants were not used since less than 2 percent of all plants are believed to fall into this category. Also, peak period employment is from about 2 to 2.5 times as large as the average monthly employment. Characteristically, fruit and vegetable processors employ many additional part-time employees during peak periods of the packing season.

The procedure stated produces the following average monthly employment estimates for the citrus processors:

Total Estimated Employment - Citrus

Small Plants	Medium Plants	Large Plants	Total U.S.
1,980	6,235	10,400	18,615

2. Apples

a. Apple Products and Pack Volumes

The apple products listed in the industry directory include the following specific products.

1. Baked apples
2. Apple rings
3. Sliced apples
4. Applesauce
5. Crabapples
6. Apple cider
7. Apple drinks
8. Apple juice

Many of these products are of only minor importance and need not be considered further. Pack statistics for the major products of interest are presented in Table II-21 to II-24 by national total and major producing state. These statistics show that apple sauce is clearly the most important specific product of those included, i.e., apple sauce, apple juice and packs of whole and sliced apples.

b. Apple Processing Plant Characteristics

The industry directory indicates that there are 144 plants engaged in the production of canned and frozen apple products. This included 128 separate firms. A further analysis of the industry listing shows that there are only 29 plants that devote their total production capacity to various apple products. The distribution of these 29 plants by specific product is presented in Table II-25.

A further breakdown of the 144 plants by specific plant characteristic is presented in Table II-26.

Table II-21. U.S. pack of canned apple sauce by state
(Thousands of actual cases -- pack beginning year shown)

State	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970*
New York	6,265	6,508	5,474	5,782	6,512	6,068	6,543	5,793	6,289	6,518
Maryland, Pennsylvania, and Virginia	7,679	8,669	8,475	10,069	11,300	5,987	9,800	9,863	11,111	8,577
Michigan	2,082	1,378	2,050	2,674	3,377	2,659	2,989	3,170	3,850	3,833
Washington, Oregon, Idaho	272	425	903	515	612	893	835	321	1,457	783
California	2,640	2,777	2,791	3,941	1,730	3,103	1,934	3,501	3,129	2,342
Other States	725	642	1,141	1,445	1,538	850	1,385	1,423	1,698	1,594
U.S. Total	19,663	20,399	20,834	24,426	25,070	19,561	23,487	24,073	27,533	23,647

*1971-72 pack to April 1 - 24,498,925 actual cases compared with 23,053,689 in same period 1970-71.

Source: Division of Statistics, National Canners Association

Table II-22. U.S. pack of canned apple juice by state
(Thousands of actual cases -- pack beginning year shown)

State	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Pennsylvania & Virginia	1,660	2,196	2,341	2,576	2,512	2,034	(a)	(a)	(a)	(a)
East	NA	NA	NA	NA	NA	NA	5,088	5,214	6,881	7,946
Michigan	1,255	785	1,145	1,113	1,700	940	(a)	(a)	(a)	(a)
Michigan & Other MW	NA	NA	NA	NA	NA	NA	1,632	1,791	2,100	2,692
California	1,283	1,344	1,151	1,933	934	1,379	982	1,629	1,792	(a)
Other West	NA	NA	NA	NA	NA	NA	1,327	1,006	2,730	3,834
Other States	2,776	3,158	3,921	4,162	4,524	4,600	(a)	(a)	(a)	(a)
U.S. Total	6,974	7,483	8,558	9,784	9,670	8,953	9,029	9,641	13,503	14,472

Source: Division of Statistics, National Canners Association

Table II-23. U.S. pack of canned apples by state

(Thousands of actual cases -- pack beginning year shown)

State	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970*
New York	1,002	928	974	1,055	1,005	1,033	1,001	927	809	626
Maryland, Pennsylvania, & Virginia**	2,360	2,414	2,300	2,266	2,737	1,567	2,047	2,007	1,682	1,007
Washington, Oregon, & Idaho	233	424	485	317	345	515	385	314	328	301
Other States	392	270	302	290	322	368	243	356	308	388
U.S. Total	3,986	4,036	4,062	3,928	4,409	3,483	3,676	3,604	3,128	2,271

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*1971-72 pack to April 1st - 2,535,062 basis 6/10's compared with 2,183,369 in same period 1970-71

**Beginning 1970 does not include Maryland

Source: Division of Statistics, National Canners Association

Table II-24. Total U.S. frozen pack of apples and applesauce
(Thousands of pounds)

	Year							
	1964	1965	1966	1967	1968	1969	1970	1971
Apples and Applesauce	86,843	93,392	94,352	97,634	117,218	122,293	100,370	96,999

Source: THE ALMANAC of the Canning, Freezing, Preserving Industries, for 1972.

Table II-25. Distributuion of 29 apple(only) plants by specific product

Product	Number of Plants
Sliced only	4
Juice only	1
Cider only	4
Sauce only	2
Cider and juice	8
Sauce and juice	2
Sliced, sauced, cider and juice	1
Sauce, cider, and juice	4
Sliced, sauce, and juice	2
Baked, rings, sliced, sauce, cider, and juice	1
Total	29

Table II-26. Characteristics of apple processing plants

Number of Plants by Specific Characteristic		
	Type of Product	
Apples Only	Fruit Only	Fruits and Vegetables
29	58	57
	Type of Plant	
Canner	Freezer	Both
97	28	19
	Size of Plant	
Small	Medium	Large*
63	42	39
	Number of Products	
Apples Only	Few (2 to 5 products--other than apples)	Many (6 or more products other than apples)
29	51	63

* Size categories correspond to those used in Table II-20.

Source: The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.

The above tabulations indicate that 80 percent of the apple processing plants also process other fruits and vegetables. Most (67 percent) are canners, 19 percent are freezers, and the rest can and freeze apple products. Forty-four (44) percent are small sized plants and 42 percent process six or more products other than apples. The typical apple processing plant is, therefore, (based on the above percentages) a small canner that processes a diversity of products.

Employment in the above specific product sector of the industry can be estimated in a manner similar to that used to derive estimated employment in citrus plants. The same average employment figures were utilized and the results are as follows:

Total Estimated Employment - Apples

Small Plants	Medium-sized Plants	Large Plants	Total U.S.
3,465	6,090	10,400	25,155

3. Spinach

a. Number of Plants and Volume of Pack

The industry directory indicates that 52 plants from 42 firms engage in canning and/or freezing spinach and other products. Table II-27 presents the canned spinach pack by production area and by total frozen spinach packs.

b. Spinach Plant Characteristics

The specific plant characteristics or patterns established in the above discussion are equally appropriate for spinach processors. As Table II-28 indicates, the 52 plants that process spinach are not specialized by product or type of plant.

Table II-27. Canned and frozen spinach packs by state
(Thousand of cases, basis 24 No. 303 cans
for canned, thousand pounds for frozen)

State	Year									
	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Canned										
Arkansas, Oklahoma & Tennessee	2,591	2,688	2,268	2,485	2,914	2,380	3,564	2,975	2,197	332
California	3,801	3,296	3,815	2,670	2,809	4,064	3,320	2,928	3,129	4,181
Other states	874	2,047	1,558	1,240	1,231	965	1,116	678	1,944	3,162
Total	7,266	8,031	7,641	6,395	6,854	7,409	7,990	6,577	7,270	7,675
Total U.S. Frozen	NA	NA	126,957	122,264	142,931	153,228	153,960	107,182	145,694	156,991

Source: Division of Statistics, National Canners Association

Table II-28. Number of spinach plants by specific characteristics

Number of Plants by Specific Characteristic		
	Type of plant	
Canner	Freezer	Both
27	23	2
	Type of Product	
Vegetable		Fruit and Vegetable
30		22
	Size of Plant*	
Small	Medium	Large
9	15	28
	Number of Products	
Single (Spinach only)	Few (2-5)	Many (6 and over)
0	15	37

* Size categories correspond to those used Table II-20.

Source: The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.

Approximately half of all spinach plants are canning plants. The plant listings also indicate that 58 percent of the spinach processing plants process other vegetables while 42 percent process fruit products in addition to vegetables. Only 17 perennt of all spinach processors are classified as small while 54 percent are large processing plants. As indicated earlier, there are no processors that process only spinach. Approximately 70 percent of those plants that process spinach process at least six other fruit or vegetable products.

Employment estimates were again, derived by estimating plant employment by plant size classification. The distribution is as follows: [1]

Total Estimated Employment - Spinach

Small Plants	Medium Plants	Large Plants	Total
495	2,175	11,200	13,870

4. Asparagus

a. Asparagus Plants and Pack Volumes

The situation for asparagus is very comparable to that of spinach. There are 60 plants consisting of 58 firms that process asparagus and other products.

b. Asparagus Processing Plant Characteristics

The characteristics of the 60 plants that process asparagus are similar to those associated with fruit and vegetable canning and freezing plants in general. Table II-29 presents the general characteristics of the 60 - plants that process asparagus.

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[1] Estimates reflect plant employment and not product line (spinach) employment per se.

Table II-29. Specific plant characteristics of 60 plants that process asparagus.

Number of Plants by Specific Characteristics		
	Type of Plant	
Canner	Freezer	Both
40	18	2
	Type of Product	
Vegetable		Fruit and Vegetable
26		34
	Size of Plant	
Small	Medium	Large
17	18	25
	Number of Products	
Single	Few	Many
0	40	20

Source: *The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.*

The above table indicates that asparagus processors consist mostly of canners that process a variety of other fruit and vegetable products. The size distribution on the basis of annual pack indicates that approximately 60 percent are small and medium sized plants while 40 percent are large plants. No plant processes only asparagus.

5. Potatoes

a. Potato Products and Pack Volumes

The industry directory includes the following potato products:

1. Whole or sliced
2. French fried
3. Hash browns
4. Flakes
5. Sticks
6. Salad

A summary of the industry Directory indicates that 103 plants and 89 firms process potato products. This includes 29 plants that process only potatoes. A breakdown of other plant characteristics is presented in Table II-30.

Applying average employment figures by size of plant produce the following employment distribution:

Estimated Total Employment - Potatoes
(Potato Canning and Freezing Only)

Small	Medium	Large	Total
1,265	4,495	19,600	25,360

The data for the potato segment reflects only canning and freezing operations listed in the Directory. They exclude many major potato dehydrators.

6. Dehydrating Plants

The above discussion summarized many salient characteristics of plants producing citrus, apples, spinach, asparagus and potatoes. For the most part, dehydrating plants have been deleted from the discussion. With the exception of apples and potatoes, the above products are not dehydrated in significant quantities. For example, the 1967 Census of Manufactures indicates the following dehydrated products and processing volumes.

Table II-30. Plant characteristics of 103 potato processing plants.

Number of Plants by Specific Characteristic

Type of Product

Vegetable Only	Fruit and Vegetable
75	28

Size of Plant

Small	Medium	Large
23	31	49

Number of Plants

Single Plant Firms	Few Plants (2-5)	Many Plants (6 and over)
29	22	52

Type of Plant

Canner	Freezer	Dehydrator	Canner & Freezer	Canner & Dehydrator	Freezer & Dehydrator
49	32	6	6	2	8

Source: The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.

Product	Volume (million pounds)	Percent of total pack
Raisins	402.2	28
Prunes	288.3	20
Figs	21.4	1
Dates	N.A.	N.A.
Apples	31.1	2
Other fruit	50.8	4
Potatoes	322.4	22
Other Vegetables	136.0	9
Other fruits and vegetables (not elsewhere classified)	14.6	1
Soup mixes and other products	173.4	12
Total Pack	1,442.2	100%

Since the dehydrating segment of the industry is relatively small when compared with the canning and freezing segments, and the specific products this tudy emphasized are not important dehydrated commodities, this report concentrated on only the two major segments of the industry.

Further work whould be done in reference to the potato dehydrating industry. It is recognized that the specific plant data contained in the Directory is not adequate for Potato dehydrating. Other sources were explored, but specific plant data for potato processors were not available.

7. Model Plants

As may be expected from the results of the above summary of specific plant characteristics by specific product, it was difficult to construct model plants that adequately typify the production.

Model plants have been constructed for apples, citrus and spinach products. This includes both canned and frozen products. A more detailed discussion of model plants for these commodities as well as a discussion of data problems encountered in constructing model potato plants are presented in Chapter III.

E. Specific Products Relative to the Industry

The preceding section discussed the plant characteristics of the five specific products considered in this report. The present section explores the relative importance of these products in the fruit and vegetable canning, freezing and dehydrating industries.

1. Specific Vegetable Products Relative to the Canned Vegetable Industry

The relative importance of any specific product can best be portrayed simply by presenting the volume of annual pack by specific product relative to the appropriate industry totals. This information is presented below for canned asparagus, potatoes and spinach.

Product	Volume Pack (thousands of cases --24 No. 303)	Percent of total canned vegetable pack (1970 by product to 1970 total vegetable pack)
Asparagus	5,972	2.1
Potatoes, white	6,602	2.3
Spinach	7,270	2.6
Total	19,844	7.0

Annual volume pack for the three products totaled only 19,844 thousand cases on a 24 count No. 303 basis. This amounted to 7 percent of the total canned vegetable pack. On a product by product basis the summary shows that all of the specific products accounted for approximately 2 percent of the total canned vegetable pack. On the other hand green beans, sweet corn and canned tomatoes contributed 45 percent of the total canned vegetable pack. The specific vegetable products considered herein must, therefore, be viewed as relatively minor components of the vegetable canning industry.

2. Specific Vegetable Products Relative to the Vegetable Freezing Industry

The situation is quite different for the specific products relative to the frozen vegetable segment of the industry. The following summary shows that potatoes account for over 50 percent of the frozen vegetables pack while asparagus comprises 0.6 percent and spinach 3 percent.

Product	Volume Pack */	Percent of total frozen vegetable pack
Asparagus	29,959	0.6
Potatoes, white	2,565,118	56.0
Spinach	156,991	3.0

*/ Thousands of pounds

3. Specific Fruit Products Relative to Total Packs of Canned Fruit and Fruit Juices

Table II-31 shows that canned apples comprise only 1 percent of the total canned fruit and fruit juice packs while apple juice contributes 7 percent to the total canned fruit and fruit juice packs. Apple sauce, however, constitutes 12 percent of the total canned fruit and fruit juice pack. Together apples, applesauce and apple juice constitute 20 percent of the total canned fruit and fruit juice pack.

Citrus is also a major commodity in the canned fruit and fruit juice segment of the industry. Twenty-three percent of the total pack consists of citrus fruit and citrus juice packs.

4. Specific Fruit Products Relative to Frozen Fruit Industry

A similar review of U.S. pack statistics reveals that frozen apples and apple sauce comprise 15 percent of the total frozen fruit industry pack. Frozen citrus packs also contribute a substantial portion and must be considered to be a major commodity in the total frozen fruit pack.

Table II-31. Summary of canned fruit and fruit juice packs

	1970	Percent 1970 to total fruit and juice, 1970
	(thousands of actual cases)	
Fruits		
Apples	2,271	1
Applesauce	23,647	12
Grapefruit sections	3,629	2
Total all fruits	135,405	66
Fruit Juices		
Apple juice	14,472	7
Grapefruit juice	23,854	12
Orange juice	16,966	8
Bl citrus juice	2,046	1
Total fruit juice	69,725	34
Total all fruits and fruit juices	205,130	100

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1972, Edward E. Judge & Sons, Westminster, Md., 1972.

5. Specific Products Relative to the Dehydrating Industry

A review of 1967 census data reveals that the dehydrated food industry shipped a total of 1,442 million pounds of fruit, vegetables and dehydrated soup mixes. A breakdown of the specific dehydrated products was presented earlier (p. II-50).

F. Significant Impacts in the Industry

Because of the unique structure and competitiveness of the fruit and vegetable processing industry, pollution abatement standards when imposed on the industry will have serious consequences on the industry itself. The magnitude of this impact will, of course, depend on the level of investment required to meet the specific standards. The smaller third--and to some extent the middle third--of the plants are expected to be seriously impacted. They may not be able to recover the cost of installing and operating the abatement facilities unless they have access to low cost facilities or municipal treatment systems. The specific plant impacts will, of course, depend on many factors such as size of plant, profitability of the plant, location and availability of low cost treatment strategies, and prevailing waste-water treatment facilities. Some of these factors are discussed below.

1. Capacity of Low-Cost Producers Relative to High-Cost Producers

The capacity of low cost producers relative to high-cost producers is the single-most important factor in considering the impact of pollution abatement costs imposed upon the industry. The industry is currently operating at about 75 percent of capacity. In the canning industry the largest third of the plants pack approximately 80 percent of the total volume. The middle-third of the plants pack about 15 percent, and the smallest-third can only 5 percent of the total pack. Due to economies of scale, the larger plants already have a definite cost advantage. The imposition of high pollution abatement costs on the smallest-third of the plants, and to a large extent, the middle-third, will result in further dis-economies to the low-volume plants. If the small plants are forced to shut down (unless, of course, low cost abatement procedures can be utilized, such as municipal sewage plants) the low cost, high volume plants in the industry could easily offset possible losses in capacity among the high cost producers.

Location of plants with excess capacity is another aspect which required consideration and further analysis. For many products, regional distributions of alternative-sized plants are not uniform; hence, significant regional dislocations in processing (and at the grower level) can be expected, for there are counties throughout the U. S. that have a significant percentage of their labor force employed in small processing plants, plants which are expected to be severely impacted.

2. Factor Dislocations Within the Industry

Different impacts from pollution abatement controls are expected within the fruit and vegetable processing industry, both in terms of type of firm and in the regional location of affected plants. The impacts expected and reasons for their associated dislocations are as follows.

a. Types of Firms and Their Location

As explained earlier, the fruit and vegetable processing industry is comprised of many firms differing in process (canning, freezing), products processed (multi/single), size (rate per hour), length of season (long/short), capacity and utilization of capacity, level of technology (new/old), and other factors. Many of these factors were considered in above preliminary analyses, and the most critical measure in terms of assessing a firm's ability to withstand the impact of internalized pollution abatement costs is its overall throughput size.

In order to represent types of firms in the industry, a series of plants were defined and referred to as being eigher small, medium, or large. In all cases, these plants were reflective of throughput size or total volume packed.

Marginal Firms - Within the fruit and vegetable industry, marginal firms are typically the "small" and single plant firms. This is particularly true in terms of a small firm's financial ability to withstand the projected high capital investment requirements of internalized pollution abatement measures. Such plants simply lack capacity to pay out such investments (at the levels given). Many single plant firms also lack the capital-acquiring ability of larger multiplant firms.

Within this framework, marginal firms faced with the decision to either curtail employment or shut down would most likely shut down. Pollution abatement investment costs would be an incentive to expand production, not lower it, in order to cover additional costs.

Because of the rather widespread underutilization of total capacity in the industry, marginal firms will usually not attempt to expand their existing facilities to achieve desired economies of scale; the competitive structure of the industry will encourage plant closure for such firms. As previously mentioned, downward trends in the number of both canning and freezing plants are occurring. Pollution abatement controls would hasten this trend of total firms in the industry.

Locational Impacts - Only general patterns of location of plants by size category were assessed in this phase of the study, but from this alone it is believed that regional differences in impact will occur following standard adoption of pollution abatement controls.

Another study recently completed has shown that on the basis of . average employment estimates and probable closures, the county unemployment generated could be as great as 4 percent of total county employment in selected counties.

3. Reasons for Dislocations

The reasons for the above type of firm and location-dependent expected dislocations within the industry were generally described already. A summary in terms of profitability and capital availability is appropriate, however.

Profitability - The profitability of firms, and particularly of the smaller inefficient and under-capitalized firms, will be affected by pollution abatement measures. While average incremental costs for pollution abatement are expected to be passed through to consumers, the smaller firms will have much higher than average per unit costs of abatement.

Economies of scale in pollution control are apparent, and this is, naturally, to the relative disadvantage of smaller firms. As previously suggested, many of the smaller firms might be forced out of the industry. Because this would have a limited desirable impact on the remaining firms which could spread pollution control costs over a larger volume, the level of profitability of the surviving plants might be affected less than average.

Capital Availability - Capital within the fruit and vegetable industry is obtained primarily from commercial sources outside the industry and from the investment of profits. Additional capital requirements for financing pollution abatement measures will also principally be sought from such sources.

In this case, availability of additional capital is expected to be determined by an individual firm's ability to project adequate net returns following an expanded investment program. Consequently, capital availability is expected to be directly related to profitability--and the smaller, inefficient firms will have difficulty raising the needed capital to stay in business. In this sense, lack of capital availability will contribute to the shutting down of marginal processing firms. In this regard, single plant firms are also in an unfavorable position relative to multiplant firms.

III. FINANCIAL PROFILE

To ascertain the economic impact of pollution abatement costs on product segments of the fruit and vegetable processing industries, it was critical to assess the differential impacts on representative plants within the industry. All firms are not affected equally in terms of per unit cost of abatement. Economies of scale will exist in controlling pollutants associated with processing.

A microeconomic evaluation of plants within the fruit and vegetable processing industry for the product segments as outlined in the RFP was needed to assess probable impacts within the industry. From this base of information, overall impacts on the industry were projected.

The model plant data were then compared with certain financial data on the canning and freezing industries obtained from IRS financial ratios and other industry sources. These data, however, were based on broad industry averages and did not permit examination of individual products or plants. In the absence of specific plant or product data, the industry averages provided some broad benchmarks for evaluation purposes.

A. Model Plants by Segment

The basic methodological approach used in this analysis involved economic engineering--the synthesis of cost and return data for individual representative processing plants within the given product categories. A broad range of "representative plant operations" were developed in order to generalize the individual plant impacts. A key variable or factor in this regard was the size of operation, e.g., small, medium and large, for various fruit and vegetable processing plants. Patterns of impact among different size categories across different products were important in terms of generalizing from individual plant data.

This study projected the anticipated annual financial activities of the model plants for a twenty year period. The models included EPA's estimated pollution abatement costs and considered production both with and without internal pollution abatement controls.

Representative plants for which economic cash flows were developed are shown in Table II-1. Because of the wide variety of products produced in each segment, the analysis has been confined only to major product lines. Representative plants were selected on the basis of major products packed and the availability of detailed plant data.

Small, medium, and large plants were analyzed for the high volume lines of citrus, apple, and spinach. Based on average industry production, a small plant model was developed with a throughput approximately equal to the average throughput of the smallest 33 percent of the firms in the industry--normally, 100 to 200 cases per hour. The median one-third of the industry was represented by a model producing from 200 to 500 cases per hour. The largest plants were represented by a 600 to 1,500 cases per hour model. Freezing plants were based on a similar scale based on pounds of finished product rather than cases.

It should be noted that approximately two-thirds of the canning and freezing plants are multiproduct firms; however, this analysis was limited to specific products so the multiplant concept was excluded. Multiproduct plants normally process any locally available variety of products. Two exceptions to this generalization are the potato industry and citrus industry where a plant may process various types of potato and citrus products, but generally have not integrated across product lines to the same extent.

1. Potatoes

After a search of the USDA, university, and trade organizations, no information regarding individual plant volume, cost of processing or investment was obtained for the potato industry. (Limited information was obtained regarding total pack by types, plant numbers, and total volume trends as contained in Chapter II. Also, see Appendix A.)

2. Citrus

Model plants--small, medium, and large--were developed for two major citrus products, frozen concentrated orange juice and single-strength, canned orange juice (see Table III-1). Length of season was set at 2,880 hours, a 6 month processing season from early January through June. Plants operate 7 days a week and frequently 24 hours a day during the heavy season. Sixteen hours per day was used as an average.

Table III-1. Capacities, length of operating season and annual pack for representative canning and freezing plant.

Product	Unit	Size	Operating Capacity Per Hour	Length of Season	Annual Pack
	(cases or lbs.			(hours)	(90% util.)
Orange juice, frozen conc.	48/6 oz.	S	140	2,880	360,000
"		M	490	2,880	1,260,000
"		L	1,000	2,880	2,700,000
Orange juice, ss canned	12/46 oz.	S	100	2,880	259,200
"		M	200	2,880	518,400
"		L	500	2,880	1,296,000
Apple slices, canned	6/10	S	200	900	162,000
"		M	400	900	324,000
		L	600	900	495,000
Apple juice, canned	12/3	S	218	900	176,400
"		M	435	900	352,800
"		L	653	900	529,200
Apple slices, frozen	lbs.	S	9,600	900	7,776,000
"		M	19,200	900	15,552,000
"		L	28,800	900	23,328,000
Spinach, canned	303 eq	S	100	500	45,000
"		M	400	500	180,000
"		L	1,200	500	540,000
Spinach, frozen	lbs.	S	1,500	500	675,000
"		M	6,000	500	2,700,000
"		L	22,500	500	10,125,000

Basic plant data was obtained from an annual series of publications by A. H. Spurlock entitled "Cost of Processing, Warehousing and Selling Florida Citrus Products," Food and Resource Economic Department, University of Florida. Data used was for the 1971-72 season.

Processing costs (no capital investment costs included) were analyzed for other canned juices including grapefruit, tangerine, and blended. Cost of processing varied only by one cent per case with the exception of that for tangerine juice which averaged about 5 cents per case difference. Orange juice was considered representative.

Frozen orange concentrate represents 93 percent of the total frozen citrus concentrate pack and was used in this analysis.

3. Apples

Four major types of apple processing plants were developed: canned slices, canned sauce, canned juice and frozen slices. Dried and dehydrated apples, only 6 percent of the total pack, were omitted. Length of season for the various size plants was set at 900 processing hours.

Basic plant data on processing and investment costs was obtained from Jorge Gutierrey Villarreal, "Investment Alternatives in the Processing of North Carolina Apples," Department of Economics, North Carolina University, 1972. These costs were updated to the 1971-72 pack year and approved by industry specialists.

4. Spinach

Model plants for both the canning and freezing of spinach were developed. All plants processing spinach also process other fruits and vegetables. Three sizes of plants for both freezing and canning of spinach with a length of season determined to be 500 hours were developed from published sources. In each case, data were constructed from simulated plant operations versus actual industry costs. The basic data sources were Mathia, Pearson and Ela, "An Economic Analysis of Canning Leafy Greens, Lima Beans and Southern Peas," Economics Information Report No. 18, Department of Economics, North Carolina State University at Raleigh, 1970, and Brocher and Pearson, "Commercial Freezing of Six Vegetable Crops in the South," MRS Report No. 926, Economic Research Service, USDA, 1971.

5. Asparagus

No detailed information regarding cost of processing asparagus could be obtained from published sources. As with spinach, no plants could be identified that process only asparagus.

B. Model Plant Configuration

The detailed specification for each model plant configuration are presented in Tables III-2 to 8. Revelant portions are then summarized in Tables III-9 to 11.

1. Utilization

It is generally recognized that fruit and vegetable plants are currently operating at a level of less than capacity. For the purposes of this report plants costed out at 100 and 90 percent of operating capacity during the operating season.

2. Description of Cost and Revenue Components

Revenues - were based on the average f.o.b. plant prices for the canning year. These prices were obtained from various recognized published sources including: Canning Trade, Quick Frozen Foods, and others.

Raw product costs - were developed on the basis of the tonnage of raw product required to yield a given number of cases or product of processed product. Average f.o.b. plant prices were used for the 1971-72 processing season.

The following physical relationships were used:

Frozen orange juice concentrate - 135 lbs. oranges per case, 48/6 oz.
Canned single strength orange juice - 68 lbs. oranges per case, 12/46
Canned apple slices - 67 lbs. apples per case, 6/10
Canned apple sauce - 31 lbs. apples per case, 24/303
Canned apple juice - 100 lbs. apples per 9 gals. juice
Frozen apples - 100 lbs. apples per 72 lbs. frozen
Spinach, canned - 18.18 lbs. raw spinach per case, 24/303
Spinach, frozen - 100 lbs. spinach per 70 lbs. frozen

Product related expenses - (other direct costs) were developed from the previously mentioned plant studies, updated, and adjusted to the plant types and sizes indicated, and checked against performance data from industry sources. This normally included processing labor, containers, sugar and spices, power, fuel, water, and variable repairs.

Plant related expenses - (indirect costs, included management, administrative expense, selling, and other.

Depreciation - was based on a 20-year life for buildings and a 15-year life for equipment of the estimated replacement cost of the plant. In the case of citrus, no replacement costs were available so the average industry depreciation cost was used as reported by IRS in the Almanac of Business and Industrial-Financial Ratio.

Table III-2. Estimated cash flow for frozen concentrated orange juice

	140 cases/hr - 144 TPD			490 cases/hr - 528 TPD			1,000 cases/hr - 1,072 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Annual throughput (48/6 oz)		400,000	360,000		1,400,000	1,260,000		3,000,000	2,700,000
Sales (000)	7.52	3,008	2,707	7.52	10,538	9,475	7.52	22,560	20,304
Product related expenses (000)	5.78	2,312	2,080	5.78	8,092	7,282	5.78	17,340	15,606
Plant related expenses (000)		267	267		936	936		2,006	2,006
Cash earnings (000)		429	360		1,510	1,257		3,214	2,692
Depreciation 1/ (000)		97	97		271	271		474	474
Interest (000)		36	36		190	190		406	406
Pre-tax income (000)		296	227		1,049	796		2,334	1,812
Income tax (000)		136	102		497	376		1,115	864
After-tax income (000)		160	125		552	420		1,119	948
Annual cash flow (000)		257	222		823	691		1,593	1,422
DCF cash flow (000)		293	258		1,013	881		1,999	1,828
Replacement investment 1/ (000)		1,582	1,582		4,405	4,405		7,694	7,694
Total working capital (000)		1,002	901		4,215	3,790		9,024	8,121
Total		2,025	1,924		7,803	7,378		16,718	15,815

Table III-2 (continued)

	140 cases/hr - 144 TPD			490 cases/hr - 528 TPD			1,000 cases/hr - 1,072 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets (000)		791	791		2,202	2,202		3.847	3.847
Total working capital (000)		1,002	901		4,215	3,790		9,024	8.121
Current liabilities (000)		644	579		2,255	2,028		4,828	4,345
Average fixed investment (000)		1,149	1,113		4,162	3,964		8,043	7.623
					Percent				
Pre-tax income/av. fixed inv.		25.8	20.4		25.2	20.1		29.0	23.8
Net income/av. fixed inv.		13.9	11.2		13.3	10.6		13.9	12.4
Annual cash flow/av. fixed inv.		22.4	20.0		19.8	17.4		19.8	18.6

1/ Preliminary

Table III-3. Estimated cash flow for single strength orange juice canning plants

	100 cases/hr - 54 TPD			200 cases/hr - 109 TPD			500 cases/hr - 272 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Annual throughput (12/46 oz. cases eq.)		288,000	259,200		576,000	518,400		1,440,000	1,296,000
Sales (000)	4.25	1,224	1,102	4.25	2,448	2,203	4.25	6,120	5,508
Product related expenses (000)	3.459	996	897		1,992	1,793		4,981	4,481
Plant related expenses (000)		145	145		291	291		727	727
Cash earnings (000)		82	60		165	119		412	298
Depreciation (000)		32	32		59	59		129	129
Interest (000)		15	15		44	44		110	110
Pre-tax income (000)		35	13		62	16		173	59
Income tax (000)		10	3		23	4		77	23
After-tax income (000)		25	10		39	12		96	36
Annual cash flow (000)		57	42		98	71		225	165
DCF cash flow		72	57		142	115		335	275
Replacement Investment[1/] (000)		512	512		958	958		2,086	2,086
Total Working Capital (000)		407	366		979	881		2,448	2,203
Total (000)		919	878		1,937	1,839		4,534	4,289

Table III-3 (continued)

	100 cases/hr - 54 TPD			200 cases/hr - 109 TPD			500 cases/hr - 272 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets (000)		256	256		479	479		1,043	1,043
Total working capital (000)		407	366		979	881		2,448	2,203
Current liabilities (000)		262	236		524	471		1,310	1,179
Average fixed investment (000)		401	386		934	889		2,181	2,067
					Percent				
Pre-tax income/av. fixed inv.		8.7	3.4		6.6	1.8		7.9	2.9
Net income/av. fixed inv.		6.2	2.6		4.2	1.3		4.4	1.7
Annual cash flow/av. fixed inv.		14.2	10.9		10.5	8.0		10.3	8.0

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[1] Preliminary

Table III-4. Estimated cash flow for canned apple slices

	200 cases/hr - 32 TPD			400 cases/hr - 64 TPD			600 cases/hr - 96 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Annual throughput (Cases 6/10)		180,000	162,000		360,000	324,000		540,000	495,000
Sales (000)	6.30	1,134	1,020	6.30	2,268	2,041	6.30	3,402	3,062
Product related expenses (000)	4.83	870	783	4.58	1,649	1,484	4.53	2,446	2,242
Plant related expenses (000)		166	160		270	270		380	380
Cash earnings (000)		98	77		349	287		576	440
Depreciation									
Bldg. 5% (000)		26	26		41	41		51	51
Equip. 6.6% (000)		27	27		43	43		63	63
Interest (000)		14	14		41	41		61	61
Pre-tax income (000)		31	10		224	162		401	265
Income tax (000)		9	3		102	72		187	121
After-tax income (000)		22	7		122	90		214	144
Annual cash flow (000)		75	60		206	174		328	258
DCF cash flow (000)		89	74		247	215		389	319
Replacement investment (000)		918	918		1,476	1,476		2,076	2,076
Total working capital (000)		378	340		907	816		1,361	1,225
Total		1,286	1,258		2,383	2,282		3,437	3,301

continued....

Table III-4. Estimated cash flow for canned apple slices (continued)

	200 cases/hr - 32 TPD			400 cases/hr - 64 TPD			600 cases/hr - 96 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets (000)		459	459		738	738		1,038	1,038
Total working capital (000)		378	340		907	816		1,361	1,225
Current liabilities (21.4) of sales (000)		243	218		485	437		728	655
Average fixed investment (000)		594	581		1,160	1,117		1,671	1,608
					Percent				
Pre-tax income/av. fixed investment		05.2	01.7		19.3	14.5		24.0	16.5
Net income/av. fixed investment		03.7	01.2		10.5	08.1		13.3	09.0
Annual cash flow/av. fixed investment		12.6	10.3		17.8	15.6		19.6	16.0

Table III-5. Estimated cash flow for canned apple sauce plants

	Small 32 TPD			Medium - 64 TPD			Large - 96 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Annual throughput 6/10s		60,000	54,000		120,000	108,000		180,000	162,000
		290,250	261,225		580,500	522,450		870,750	783,675
Sales (25% 6/10s)	5.13	308	277	5.13	616	554	5.13	923	831
(75% 303s)	3.62	1,051	946	3.62	2,101	1,891	3.62	3,152	2,837
Total sales (000)		1,359	1,223		2,717	2,445		4,075	3,668
Product related expenses (000)		1,072	965		2,061	1,855		3,096	2,786
Plant related expenses expenses (000)		183	183		306	306		434	434
Cash earnings (000)		104	75		350	284		545	448
Depreciation (000)									
Bldg. (5%)		26	26		30	30		59	59
Equip. (6.6%)		27	27		43	43		62	62
Interest (000)		16	16		49	49		73	73
Pre-tax income (000)		35	6		228	162		351	254
Income tax		11	2		104	72		163	116
After-tax income (000)		24	4		124	90		188	138
Annual cash flow		77	57		197	163		309	259
DCF Cash Flow		93	73		246	212		382	332
Replacement Investment (000)		928	928		1,250	1,250		2,120	2,120
Total Working Capital		453	408		906	815		1,358	1,222
Total		1,381	1,336		2,156	2,065		3,478	3,342

Table III-5 (continued)

	Small - 32 TPD			Medium - 64 TPD			Large - 96 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets (000)		464	464		625	625		1,060	1,060
Total Working Capital (000)		453	408		406	815		1,358	1,222
Current Liabilities (21.4) of sales (000)		291	202		581	523		872	785
Average fixed investment (000)		626	610		950	917		1,546	1,497
				Percent					
Pre-tax income/av. fixed investment		5.6	1.0		24.0	17.7		22.7	17.0
Net income/av. fixed investment		3.8	.7		13.0	9.8		12.2	9.2
Annual cash flow/av. fixed investment		12.3	9.3		20.7	17.8		20.0	17.3

Table III-6. Estimated cash flow for canned apple juice plants

	218 cases/hr - 48 TPD			435 cases/hr - 96 TPD			653 cases/hr - 144 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Annual Throughput (12/3)		196,000	176,400		392,000	352,800		588,000	529,200
Sales (000)	3.60	705	635	3.60	1,411	1.270	3.60	2,116	1,905
Product Related Expenses (000)	2.50	490	441	2.30	900	811	2.29	1,346	1,211
Plant Related Expenses (000)		135	135		210	210		289	289
Cash Earnings (000)		80	59		301	249		481	405
Depreciation (000)									
Bldg. (5%) (000)		9	9		15	15		22	22
Equip. (6.6%) (000)		13	13		15	15		21	21
Interest (000)		8	8		25	25		38	38
Pre-tax Income (000)		50	29		246	194		400	324
Income Tax (000)		18	8		112	87		186	149
After-tax income (000)		32	21		134	107		214	175
Annual cash flow (000)		54	43		164	137		257	218
DCF cash flow		62	51		189	162		295	256
Replacement investment (000)		395	395		540	540		740	740
Total working capital (000)		234	211		564	508		846	762
Total (000)		629	606		1,104	1,048		1,586	1,502

continued ....

Table III-6 (continued)

	218 cases/hr - 48 TPD			435 cases/hr - 96 TPD			653 cases/hr - 144 TPD		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets (000)		198	198		270	270		370	370
Total working capital		234	211		564	508		846	762
Current liabilities (21.4) (000)		151	136		302	271		453	407
Average fixed investment (000)		281	273		532	507		763	725
					Percent				
Pre-tax income/ave. fixed investment		17.8	10.6		46.2	38.3		52.4	44.7
Net income/av. fixed investment		11.4	7.6		25.1	21.1		28.0	24.1
Annual cash flow/av. fixed investment		19.2	15.8		30.8	27.0		33.6	30.1

Table III-7. Estimated cash flow for frozen apple slices plant

	9,600 lbs. per hour			19,200 lbs. per hour			28,800 lbs. per hour		
	$/lb.	Annual	Annual	$/lb.	Annual	Annual	$/lb.	Annual	Annual
Utilization		100	90		100	90		100	90
Annual throughput (000 lb)		8,640	7,776		17,280	15,552		25,920	23,328
Sales (000)	.151	1,305	1,174	.151	2,609	2,348	.151	3,913	3,522
Product related expenses (000)	.153	1,326	1,193	.149	2,581	2,323	.148	3,849	3,464
Plant related expenses (000)		179	179		297	297		421	421
Cash earnings (000)		-200	-198		-269	-272		-357	-363
Depreciation (000)									
Bldg. (5%)		47	47		81	81		113	113
Equip. (6.6%)		18	18		24	24		46	46
Interest (000)		16	16		31	31		47	47
Pre-tax income (000)		-281	-279		-405	-408		-563	-569
Income tax		--	--		--	--		--	--
After-tax income (000)		-281	-279		-405	-408		-563	-569
Annual cash flow (000)		-216	-214		-300	-303		-404	-410
DCF cash flow		-200	-198		-269	-272		-451	-457
Replacement investment (000)		1,219	1,219		2,117	2,117		3,972	3,972
Total working capital (000)		435	391		1,043	939		1,565	1,409
Total (000)		1,654	1,610		3,160	3,056		5,537	5,381

continued.....

Table III-7. Estimated cash flow for frozen apple slices plant (continued)

	9,600 lbs. per hour			19,200 lbs. per hour			28,800 lbs. per hour		
	$/lb.	Annual	Annual	$/lb.	Annual	Annual	$/lb.	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets (000)		605	605		1,059	1,059		1,986	1,986
Total working capital (000)		435	391		1,043	939		1,556	1,409
Current liabilities (21.4 of sales) (000)		279	251		558	502		837	754
Average fixed investment (000)		761	745		1,544	1,496		2,705	2,541
					Percent				
Pre-tax income/av. fixed investment		( )	( )		( )	( )		( )	( )
Net income/av. fixed investment		( )	( )		( )	( )		( )	( )
Annual cash flow/av. fixed investment		( )	( )		( )	( )		( )	( )

Table III-8. Estimated cash flow for spinach canning plant

	100 case/hr.			400 case/hr.			1,200 case/hr.		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Annual Throughput (Cases)		50,000	45,000		200,000	180,000		600,000	540,000
Sales ($1,000)	3.65	183,000	164,000	3.65	730,000	657,000	3.65	2,190,000	1,971,000
Operating Expenses		171,000	162,000		607,000	567,000		1,567,000	1,484,000
Cash Earnings		12,000	2,000		123,000	90,000		623,000	487,000
Depreciation									
Bldg. at 5%		2,250	2,250		6,100	6,100		16,200	16,200
Equip. at 6.6%		4,440	4,440		10,974	10,974		26,255	26,255
Interest		1,830	1,830		8,760	8,760		39,420	39,420
Pre-tax Income		3,480	-6,520		97,166	64,166		541,125	405,125
Income tax		870	-		40,890	15,050		253,990	188,710
After-tax Income		2,610	-6,520		56,276	49,116		287,135	216,415
Annual cash flow		9,300	170		73,350	66,190		329,590	258,870
DCF cash flow		11,130	2,000		82,110	74,950		369,010	298,290
Replacement investment		122,303	122,303		307,487	307,487		781,711	781,711
Total working capital		60,900	54,600		292,000	262,800		876,000	788,400
Total		183,203	176,903		599,487	570,287		1,657,711	1,570,111

continued.....

Table III-8. Estimated cash flow for spinach canning plant (continued)

	100 case/hr.			400 case/hr.			1,200 case/hr.		
	$ Case	Annual	Annual	$ Case	Annual	Annual	$ Case	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets		61,152	61,152		153,744	153,744		390,856	390,856
Total working capital		60,900	54,600		292,000	262,800		876,000	788,400
Current liabilities (21.4 of sales)		39,000	35,000		156,000	141,000		469,000	422,000
Average fixed investment		83,052	80,752		289,744	275,544		797,856	757,256
				Percent					
Pre-tax income/av. fixed investment		04.2	( )		33.5	23.2		67.8	53.5
Net income/av. fixed investment		03.1	( )		19.4	17.8		36.0	28.6
Annual cash flow/av. fixed investment		11.2	00.2		25.3	24.0		41.3	34.2

Table III-9. Estimated cash flow for spinach freezing plant

	1,500 lbs. per hour			6,000 lbs. per hour			22,500 lbs. per hour		
	$ lb.	Annual	Annual	$ lb.	Annual	Annual	$ lb.	Annual	Annual
Utilization		100	90		100	90		100	90
Annual Throughput (lbs)		750,000	675,000		3,000,000	2,700,000		11,250,000	10,125,000
Sales	.1856	139,200	125,280	.1856	556,800	501,120	.1856	2,088,000	1,879,200
Product related expenses	.0996	74,700	67,230	.1855	256,500	230,850	.0595	669,375	602,437
Plant related expenses		90,696	90,696		274,500	274,500		937,634	937,634
Cash earnings		-26,196	-32,646		25,800	-4,230		480,991	339,129
Depreciation									
Bldg. at 5%		826	826		1,991	1,991		5,212	5,212
Equip. at 6.6%		2,544	2,544		6,134	6,123		16,978	16,978
Interest		1,392	1,392		6,681	6,681		20,250	20,250
Pre-tax income		-30,968	-37,408		10,994	-19,036		438,551	296,689
Income tax		--	--		2,748			204,754	136,661
After-tax income		-30,968	-37,408		8,246	-19,036		233,797	160,028
Annual cash flow		-27,598	-34,038		16,371	-10,911		255,987	182,218
DCF cash flow		-26,206	-32,646		25,800	- 4,230		480,099	196,719
Replacement investment		551,000	551,000		1,328,000	1,328,000		3,675,000	3,675,000
Total working capital		46,000	42,000		222,000	200,000		835,000	752,000
Total		597,000	593,000		1,550,000	1,528,000		4,510,000	4,427,000

continued....

Table III-9. Estimated cash flow for spinach freezing plant (continued)

	1,500 lbs. per hour			6,000 lbs. per hour			22,500 lbs. per hour		
	$ lb.	Annual	Annual	$ lb.	Annual	Annual	$ lb.	Annual	Annual
Utilization		100	90		100	90		100	90
Average fixed assets		275,500	275,500		664,000	664,000		1,837,500	1,837,500
Total working capital		46,000	42,000		222,000	200,000		835,000	752,000
Current liabilities (21.4 of sales)		30,000	27,000		119,000	107,000		447,000	402,000
Average fixed investment		291,500	290,500		767,000	757,000		2,225,500	2,187,500
					Percent				
Pre-tax income/av. fixed investment		( )	( )		01.4	( )		19.7	13.6
Net income/av. fixed investment		( )	( )		01.1	( )		10.5	07.3
Annual cash flow/av. investment		( )	( )		02.1	( )		11.5	08.3

3. Summary of Model Plant Data

Model plant sales, variable costs, fixed costs including depreciation and interest are summarized in Table III-10. The summary is made at the 90 percent utilization level, a more realistic operating value than the hypothetical 100 percent.

Raw product cost ranges from a low of 10 percent for the spinach canning plant (slight variation due to rounding) to a high of 55 percent for frozen concentrated orange juice.

The model plant data were checked against margin data developed by ERS of USDA.[1] Generally, processor margins expand over time, and because the most current ERS estimate is for 1969-70, such variation occurs. A summary of the results is as follows:

	Processor Margins	
	Model Plants	USDA
Frozen Orange Juice	55%	53%
Canned SS Orange Juice	44	42
Applesauce, canned	31	28
Canned spinach	11	11
Frozen spinach	19	17

This brief description indicates that the revenue and raw product calculation for the model plants accurately reflect the existing industry cost relationships.

The breakdown of processing costs to other direct and indirect costs is somewhat arbitrary and does not provide a meaningful comparison among plants. The two should be summed. On that basis, they range from a low of 32 percent for frozen orange juice to a high of 77 percent for canned spinach, an expected range given existing raw product margin.

As indicated previously, depreciation was calculated on the basis of replacement cost and as expected ranged from 1 to 5 percent of sales. This is slightly higher than actual industry averages which ranged from 2.1 to 2.3 percent of sales for 1967-68 through 1969-70.

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[1] Economic Research Service, "Prices, Margin and Farm Value for Canned and Frozen Fruits, Vegetables and Juices, "Statistical Bulletin No. 420, USDA, 1971.

Table III-10. Estimated sales, variable and fixed costs and relationships for industry segments based on model plants (90 percent utilization)

			Sales		Variable costs				Fixed Costs							
					Raw materials		Other direct		Indirect		Depreciation		Interest		Total	
	Unit	Capacity	Dollars	Percent of sales	Dollars	Percent of sales	Dollars	Percent of sales	Dollars	Percent of sales	Dollars	Percent of sales	Dollars	Percent of sales	Dollars	Percent of sales
OJ, frozen conc.	48/6	400	2,707	100.0	1,483	54.78	597	22.05	267	9.86	97	3.58	36	1.2[illegible]	2,480	91.61
"	oz.	1,400	9,475	100.0	5,191	54.83	2,091	22.07	936	9.88	271	2.86	190	2.01	8,679	91.65
"		3,000	20,304	100.0	11,124	54.79	4,482	22.07	2,006	9.88	474	2.33	406	2.00	18,492	91.05
OJ, SS canned	12/48	288	1,102	100.0	488	44.28	411	37.30	145	13.16	32	2.90	15	1.36	1,091	99.00
"		576	2,203	100.0	976	44.30	817	37.09	291	13.21	59	2.68	44	2.00	2,187	99.27
"		1,440	5,508	100.0	2,440	44.30	2,041	37.06	727	13.20	129	2.34	110	2.00	5,447	98.89
Apple slices, canned	6/10	180	1,020	100.0	378	37.06	405	39.71	166	16.27	53	5.20	14	1.37	1,016	99.61
"		360	2,041	100.0	758	37.14	726	35.62	270	13.23	84	4.12	41	2.01	1,879	92.06
"		540	3,062	100.0	1,137	37.13	1,105	36.09	380	12.41	114	3.72	61	1.99	2,797	91.35
Apple sauce, canned	303 eq.	387	1,223	100.0	379	31.00	586	47.91	183	14.96	53	4.33	16	1.31	1,217	99.51
"		774	2,445	100.0	758	31.00	1,097	44.87	306	12.52	73	2.99	49	2.00	2,283	93.37
"		1,162	3,668	100.0	1,137	31.00	1,649	44.99	434	11.83	121	3.30	73	1.99	3,414	93.08
Apple juice canned	12/3	192	635	100.0	156	24.57	285	44.88	135	21.26	22	3.46	8	1.26	606	95.43
"		392	1,270	100.0	311	24.49	500	39.37	210	16.54	30	2.36	25	1.97	1,076	84.72
"		588	1,905	100.0 100.0	467	24.51	744	39.06	289	15.17	43	2.26	38	1.99	1,581	82.99
Apple slices frozen	lb.	8,640	1,174	100.0	379	32.28	814	69.34	179	15.25	65	5.54	16	1.36	1,453	123.76
"		17,280	2,348	100.0	758	32.28	1,567	66.74	297	12.65	115	4.90	31	1.32	2,768	117.59
"		25,920	3,522	100.0	1,137	32.28	2,327	66.07	421	11.95	169	4.80	47	1.33	4,101	116.44
Spinach canned	303	50	183	100.0	18	9.84	144	78.69	1/		7	3.83	2	1.09	171	93.44
"		200	657	100.0	74	11.26	493	75.04	1/		17	2.59	9	1.37	593	90.26
"		600	1,971	100.0	220	11.16	1,264	64.13	1/		42	2.13	39	1.98	1,565	79.40
Spinach frozen	lb.	750	125	100.0	24	19.20	43	34.40	91	72.80	4	3.20	2	1.60	164	131.20
"		3,000	501	100.0	97	19.36	134	26.75	275	54.89	8	1.60	7	1.40	521	103.99
"		11,250	2,088	100.0	361	17.29	241	11.54	938	44.92	21	1.01	20	.95	1,581	75.72

1/ Combined with other direct

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Interest rates were taken from IRS averages. Net profits as a percent of net sales are summarized for the model plants in Table III-11. Net profits range from < 0 to as high as 11 percent for canned spinach. A sample average of sales to net profit for the small plants is 1.6 percent, for medium plants, 4.5 percent and 5.6 percent for large plants. This compares with the industry average of 4.0 percent during the period from 1965-1967 and is slightly higher than the latest information available from published IRS data which averaged 3.2% for 1967-68, 2.6% for 1968-69, and 2.2% for 1969-70.

4. Annual Profit before Taxes

Pre-tax income, return on average invested capital before and after taxes and after tax return on sales for the types and sizes of fruit and vegetable packing plants analyzed are shown in Table III-11.

Pre-tax income was derived as follows:

Gross sales
- Raw materials cost
= Gross margin
- Direct and indirect operating expenses
= Cash earnings
- Depreciation and interest
= Pre-tax income

These data were developed from a combination of published and unpublished sources and were checked against available information on industry financial ratios and other measures of industry financial performance, to insure their reliability.

Average invested capital was calculated as follows:

Average fixed assets (1/2 of replacement cost)
+ Total working capital
- Current liabilities
= Average invested capital

Average fixed assets were estimated from previously published research (updated and adjusted for plant size and type), engineering estimates of plant and equipment, and industry information on new plant costs.

Current liabilities were estimated from industry performance ratios as reported in the Almanac of Business and Industrial Financial Ratios--1973. The uniform rate used for all plants was the three year industry average of 21.4 percent of sales.

TableIII-11. Estimated pre-tax income and rate of return on average invested capital for industry segments based on model plants.

		Season	Pre-tax Income Dollars		ROI Pre-tax Income		ROI After Tax Income	
			Utilization		Utilization		Utilization	
Plant	Unit	Capacity	100%	90%	100%	90%	100%	90%
		(000)						
Orange juice. frozen conc.	48/6 oz.	400	296	227	25.8	20.4	13.9	11.2
"		1,400	1,049	796	25.2	20.1	13.3	10.6
"		3,000	2,334	1,812	29.0	23.8	13.9	12.4
Orange juice, ss canned	12/46 oz.	288	35	13	8.7	3.4	6.2	2.6
"		576	62	16	6.6	1.8	4.2	1.3
"		1,440	173	59	7.9	2.9	4.4	1.7
Apple slices, canned	6/10	180	31	10	5.2	1.7	3.7	1.2
"		360	224	162	19.3	14.5	10.5	8.1
"		540	401	265	24.0	16.5	13.3	9.0
Apple sauce, canned	303	387	35	6	5.6	1.0	3.8	0.7
"		774	228	162	24.0	17.7	13.0	9.8
"		1,162	351	254	22.7	17.0	12.2	9.2
Apple juice, canned	12/3	196	50	29	17.8	10.6	11.3	7.8
"		392	246	194	46.2	38.3	25.2	18.2
"		588	400	324	52.4	44.6	28.0	24.1
Apple slices, frozen	lbs.	8,640	(281)	(279)	0	0	0	0
"		17,280	(405)	(408)	0	0	0	0
"		25,920	(563)	(569)	0	0	0	0

Table III-11. (Cont'd)

Plant	Unit	Season Capacity	Pre-tax Income Dollars Utilization 100%	 90%	ROI Pre-tax Income Utilization 100%	 90%	ROI After Tax Income Utilization 100%	 90%
Spinach, canning	303	50	3	(6)	3.6	0	3.1	0
"		200	97	64	33.5	23.3	19.3	17.8
"		600	541	405	67.8	53.5	36.0	28.5
Spinach, frozen	lb.	750	(31)	(37)	0	0	0	0
"		3,000	11	(19)	1.4	0	0.4	0
"		11,250	438	296	19.7	13.5	10.5	7.3

Table III-12 Estimated annual cash flow and rate of return on average invested capital for industry segments based on model plants.

Plant	Unit	Capacity	Annual Cash Flow Dollars		ROI Annual Cash Flow	
			Utilization		Utilization	
			100%	90%	100%	90%
		(000)			(Percent)	
Orange juice, frozen conc.	48/6 oz.	400	257	222	22.4	20.0
"		1,400	823	691	19.8	17.4
"		3,000	1,593	1,422	19.8	18.6
Orange juice, ss canned	12/46 oz.	288	57	42	14.2	10.9
"		576	98	71	10.5	8.0
"		1,440	225	165	10.3	8.0
Apple slices, canned	6/10	180	75	60	12.6	11.8
"		360	206	174	17.8	15.6
"		540	328	258	19.6	16.0
Apple sauce, canned	303	387	77	57	12.3	9.3
"		774	197	163	20.7	17.8
"		1,162	309	259	20.0	17.3
Apple juice, canned	12/3	196	54	43	19.2	15.8
"		392	164	137	30.8	27.0
"		588	257	219	33.6	30.1
Apple slices, frozen	lbs.	8,640	(216)	(214)	0	0
"		17,280	(300)	(303)	0	0
"		25,920	(404)	(410)	0	0

Table III-12 (continued)

Plant	Unit	Capacity	Annual Cash Flow Dollars Utilization 100%	 90%	ROI Annual Cash Flow Utilization 100%	 90%
Spinach, canning	303	50	9	1	11.2	0.2
"		200	73	66	25.3	24.0
"		600	330	259	41.3	34.2
Spinach, frozen	lbs.	750	(28)	(34)	0	0
"		3,000	16	(10)	2.1	0
"		11,250	255	182	11.5	8.3

Working capital data were estimated from actual industry performance ratios as reported from IRS data in the Almanac of Business and Industrial Financial Ratios. In the earlier study for EPA by DPRA, working capital was estimated at 33.3 percent of sales. The IRS data confirmed this level of working capital for small plants, but for medium and large plants, the level as a percentage of sales was increased to 40 percent.

Pre-tax returns on average capital varied directly by plant size with the exception of those in the citrus industry (discussed below). This ranged from a negative return for all sizes of frozen apple plants to a high of 53 percent for the large spinach canning plant at the 90 percent level of utilization.

As expected, orange juice frozen concentrate demonstrated a higher rate of profit than did canned single-strength. A uniform operating cost was used for all sizes of plants in the citrus industry as industry data indicate no direct relation between cost of processing and size of operation.

Low returns were obtained on both the frozen apple and frozen spinach plants. This can generally be explained by the high cost of investment per case of operating capacity. In order for freezing plants to operate profitably, they must pack for longer seasons and maintain higher annual throughputs per unit of capacity. For this reason, nearly all freezing plants extend their operating season by adding other products to their processing limit.

5. Annual Cashflow

The estimated annual cashflow and rate of return on average capital for model plants are shown in Table III-12. Based on the 90 percent utilization figure, percent return by plant averaged between 8 and 34 percent with the exception of the non-citrus freezing plants which remain either negative or very low. Again plant size economies of scale are evident in all but the citrus industry.

6. Market Value of Assets

The market or salvage value of processing plants will vary widely from plant to plant depending on the age of the plant, type and equipment configuration. Also the condition of plant and equipment, and location will affect the market or salvage value.

If plants are forced to close because they are presently unprofitable or would become so from pollution control costs, the salvage value of some buildings would be essentially zero. Storage areas could be converted to alternative uses, the equipment might sell from 10 to 50 percent of its original cost, and the value of the site could vary widely, depending on location. In many instances, the value of a plant, particularly where a small firm is involved, would be greater to its present owner than it would be to any potential buyer. In terms of "book value" the physical facilities and equipment may have been fully depreciated, nor nearly so, but in terms of their "use value" to their present owners, these plants represent assets with tangible values--much greater than their market or their salvage value.

No data were available on actual salvage values for fruit and vegetable plants. A "market" for plants which close because of the added costs of water pollution control would be virtually non-existent; therefore, the impact analysis used an arbitrary salvage value based upon the following assumptions: operating capital recovered intact, land valued at original cost, and buildings and equipment valued at 10 percent of replacement .

Table III-13. Estimated replacement value and gross working capital requirements for industry segments based on model plants

Type and Size	Replacement value of plant equipment & site	Total working capital requirement	Replacement value of total assets
	($000)	($000).	($000)
Frozen OJ Conc.			
Small	1,023	1,002	2,025
Medium	3,588	4,215	7,803
Large	7,694	9,024	16,718
Canned SS orange			
Small	417	407	824
Medium	835	979	1,814
Large	2,086	2,448	4,534
Apple slices canned			
Small	918	378	1,286
Medium	1,476	907	2,383
Large	2,076	1,361	3,437
Apple sauce canned			
Small	395	234	629
Medium	540	564	1,104
Large	740	846	1,586
Apple juice canned			
Small	931	452	1,383
Medium	1,508	1,087	2,595
Large	2,109	1,630	3,739
Apple slices frozen			
Small	1,219	435	1,654
Medium	2,117	1,043	3,160
Large	3,972	1,565	5,537
Spinach canned			
Small	122	61	183
Medium	307	292	599
Large	781	876	1,657
Spinach frozen			
Small	551	46	597
Medium	1,328	222	1,550
Large	3,675	835	4,510

C. Comparison of Model Plant Data with IRS Data

The selected financial data and asset size for firms in canned and frozen goods given in Table III-14 were based on the latest available 3 year results from the Almanac of Business and Industrial Ratios as developed from IRS data.

Net income as a percent of sales as derived from the industry averages amounted to 3.6 percent in 1967-68, 2.3 percent in 1968-69, and 1.8 in 1969 and 1970. Considerable variation was experienced by size of firm with the very small firm (less than $50,000 of asset) performing relatively well. There is a sharp drop in profits for the next size category with a gradual increase in profits as the firm size increases. The relatively high profits of the very small firms may be explained by their being older plants with large amounts of plant and equipment already depreciated out and having low wages for production line workers and a relatively low-level management structure. Model plants, however, show a higher net income averaging 1.6 percent for small plants, 4.5 percent for medium, and 5.6 percent for large plants (Table III-11). However, other costs such as management, advertising and G and A may be understated for the model plants.

Net income as a percent of total assets less current liabilities for the total industry was reported at a high of 7.2 in 1967-68 and decreased gradually to 5.0 in 1969-70. There are great variations by plant size with some of the small plant sizes showing returns up to 51 percent. The results generally decrease as plant sizes become larger.

The model plant data as presented in Section III-B-2 ranged from less than 0 to a high of 36 percent--averaging somewhat higher than the actual industry averages. Model plant data with the exception of citrus, demonstrated definite economies of scale with large plants demonstrating higher returns. Frozen orange juice ranged from 12 to 16 percent, canned orange juice from 1 to 2 percent and canned apples and apple sauce from 1 to 24 percent. Canned apple juice ranked similar to frozen orange juice concentrate with spinach varying widely from less than 0 to 36 percent.

Cash flow as a percent of total assets less current liabilities for the total industry are shown in Table III-12. A similar pattern exists for net income as a percent of total assets less current liabilities. The results range from a high of 12 percent for 1967-68 and decrease to 10.4 for 1969-70. The model plant data generally average between 10 and 20 percent with the exception as noted earlier dropping to 0 or increasing to 3 percent.

Table III-14. Selected financial data for firms in canned and frozen foods by asset size

	Total	Under 50	50-100	100-250	250-500	500-1,000	1,000-5,000	5,000-10,000	10,000-25,000	25,000-50,000	50,000-100,000	100,000-250,000	250,000-& over
No. of Firms reporting													
1967-68	1,805	24.3	9.4	19.9	13.0	11.9	16.0	2.9	1.4	0.5	0.1	0.2	0.2
1968-69	1,588	22.5	13.1	8.3	11.1	19.6	15.5	6.0	2.3	.5	.3	.5	
1969-70	1,707	15.8	18.7	18.6	12.0	18.9	9.9	17.4	3.0	2.4	.7	.5	
Net Income before tax as a percent of sales													
1967-68	3.6	-	-	*	*	2.2	3.0	4.5	3.4	3.2	*	4.4	6.0
1968-69	2.3	2.9	9.0	-	.6	1.6	-	*	2.6	2.1	*	4.6	N/C
1969-70	1.8	.7	*	*	*	2.4	-	2.1	1.9	1.9	.5	3.2	N/C
Net Income or percent of total assets less current liabilities													
1967-68	7.2	-	42.1	-	12.3	8.6	9.2	10.0	6.1	6.1	1.6	6.3	5.1
1968-69	6.4	51.4	39.5	11.0	6.6	8.7	6.2	5.8	5.9	6.3	1.3	6.8	
1969-70	5.0	-	-	-	4.8	7.8	5.2	6.2	5.2	5.0	6.8	3.1	
Cash flow as percent of total assets less current liabilities													
1967-68	12.0	-	41.3	-	19.9	17.7	15.9	15.3	11.7	10.6	5.5	10.8	10.9
1968-69	11.5	82.6	50.3	22.4	15.6	17.0	13.3	12.0	11.9	11.4	7.9	11.0	
1969-70	10.4	-	-	-	18.8	15.9	13.0	11.0	11.4	12.4	9.4	9.6	

Source: Almanac of Business and Industrial Financial Ratios, 1971, 1972, 1973. Ed., Prentice Hall, Inc. These data are from Internal Revenue Service Corporation Statistics and Income.

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Overall, the results of the comparison of model plant data with actual industry averages, recognizing different years are involved, indicate that the model plants are operating at a slightly higher rate of profit on sales as well as higher returns on total assets less current liabilities than actual industry performance during the 1967-70 period. The model plant data for 1971-72 would be more indicative of the 1965-67 period when profits in the industry were higher. It is evident from the industry data that wide variation exists in the industry--especially when such a broad spectrum of plant sizes, products and types of processing are averaged into one category.

Apparently, the model plants reflect conditions of individual industry segments in a representative manner. This is especially true since it is generally recognized that the industry experienced higher profits in the 1971-72 season than during the 1968-70 season.

D. Ability to Finance New Investment

The ability of a firm to finance new investment for pollution abatement is a function of several critical financial and economic factors. In general terms, new capital must come from one or more of the following sources: (1) funds borrowed from outside sources; (2) new equity capital through the sale of new common or preferred stock; (3) internally generated funds--retained earnings and the stream of funds attributed to depreciation of fixed assets.

For each of the three major sources of new investment, the most critical set of factors is the financial condition of the individual firm. For debt financing, the firm's credit rating, earnings record over a period of years, existing debt-equity ratio and the lenders' confidence in management will be major considerations. New equity funds through the sale of securities will depend upon the firm's future earnings as anticipated by investors and its past earnings records. The firm's record compared to others in its own industry and to firms in other similar industries will be a major determinant of the ease with which new equity capital can be acquired. The investor will probably look at the trend of earnings for the past five or so years.

Internally generated funds depend upon a firm's margin of profitability and its cash flow from operations. Also, in publicly held corporations, stockholders must be willing to forego dividends in order to make earnings available for reinvestment.

The condition of the firm's industry and general economic conditions are also major factors in attracting new capital. The industry will be compared to other manufacturing industries in terms of net profits on sales and on net worth, supply-demand relationships, trends in production and consumption, the state of technology, the effect of government regulations, foreign trade, and other significant variables. Declining or depressed industries are not good prospects for attracting new capital. At the same time, the overall condition of the domestic and international economy can influence capital markets.

The food canning and freezing industries in the United States are highly competitive with a large number of relatively small firms. Profit margins on sales are low and highly volatile for both individual plants and the entire industry. Detailed information on the profit position of respective type and size companies is not available. Only broad industry averages can be obtained.

According to the Census of Manufactures the total number of canning plants decreased from 1,607 in 1958 to 1,223 in 1967, a reduction of 24 percent in the 10 year period. While it cannot be quantitatively stated, it is believed that the firms which shut down are basically the older, small plants. This trend has been continuing for the past thirty years and, no doubt, will continue for some time as the smallest third of the plants account for only 5-10 of the total pack and are generally considered to be old and small.

A composite income statement for canned fruits and vegetable (SIC 2033) was obtained from the National Canners Association and is presented in Table III-15. (Profits before tax, all canners and freezers, as taken from IRS data in the Almanac of Business and Industrial Financial Ratios is included as a comparison.) No similar statement has been obtained for the freezer industry. Total sales in the canned fruits and vegetable industry amount to $3.7 billion. Labor costs amount to $613 million or 16.6 percent of sales. This has increasedfrom 15.4 percent of sales in 1965. Fresh fruit and vegetable costs declined sharply in 1969 and 1970 to 21.4 percent. Profits were also lower during the past three years and averaged 2.3 percent of sales compared with an average of 4.0 percent during the 1965 through 1967 period. According to earlier survey of income and earnings over a five year period by the National Canners Association, an average of 54 firms operated on a profitable basis each year and an average of 10 firms operated on a loss basis of about 16 percent. (According to the IRS data, 48 percent of the canners reported a negative income in the 1968-70 year, 29 percent in 1968-69 and 38 percent in 1967-68.)

When net income as a percent of equity in the fruit and vegetable canning industry was compared with other types of companies, it did so favorably. For the 1965-67 period (Table III-16) net income as a percent of equity amounted to 9.9 percent compared with 9.2 for all canned and frozen foods, 10.1 for total manufacturing, and 8.1 for all corporations. During the 1968-70 period, however, net income dropped sharply to 4.6 percent. No comparative information for other industry groups was available. No information was available as to net income by type of size of firm.

The number of freezing firms increased from 426 in 1958 to 608 in 1967 according to the Census of Manufactures. Generally, freezing plants are newer and larger than canning plants. A recent article by Quick Frozen Foods [1/] reporting the findings of their annual survey of frozen food packers (contains also seafoods, meats, prepared foods, etc.) showed that 62 percent of the frozen food packers queried intend to build new FF processing plants or renovate old ones. Approximately one-fourth of those contacted in the survey indicated expansion programs of more than $1,000,000.

With the increase in volume in the freezing industry, the increase in plant number, and the current plans for expansion, it would appear that the freezers are in a relatively better situation than canners to meet the added cost of pollution control equipment.

[1/] Katz, Arnie, "Annual Survey of Construction and Equipment Purchasing Plan," Quick Frozen Foods, Cahner Publishing Company, Inc., New York, N. Y., March, 1973.

Table III-15. Income Statement, Canned Fruits and Vegetables (SIC 2033)

	1965	1966	1967	1968	1969	1970
			Millions of Dollars			
Sales	2,982.0	3,215.8	3,467.8	3,654.1	3,670.1	3,700.0
Labor cost	457.9	492.5	536.4	582.9	594.6	613.4
Wages	317.8	341.1	376.0	409.5	419.5	424.5
Salaries	89.3	92.8	97.8	106.5	104.9	114.6
Supplementary labor costs	50.8	58.5	62.6	66.9	70.2	74.3
Materials & other costs	2,343.7	2,527.4	2,725.7	2,881.9	2,943.4	2,916.4
Fresh fruits & vegetables	702.9	769.5	812.7	876.6	810.7	793.2
Other food ingredients			170.5			
Containers	571.4	614.5	627.5	708.5	720.8	728.2
Other materials, supplies, etc.			443.8			
All other costs			671.2			
Depreciation	63.7	62.0	72.0	77.1	80.7	81.4
Profits before tax	116.7	133.9	133.7	112.2	51.4	88.8
			Percent of Sales			
Total labor cost	15.4	15.3	15.5	16.0	16.2	16.6
Wages	10.7	10.6	10.8	11.2	11.4	11.5
Fresh fruit & vegetable costs	23.6	23.9	23.4	24.0	22.1	21.4
Other food ingredient costs			4.9			
Container costs	19.2	19.1	18.1	19.4	19.6	19.7
Profits before tax	3.9	4.2	3.9	3.1	1.4	2.4
Profit before tax, all canners & freezers	-	-	-	3.6	2.3	1.8

Source: National Canners Association, developed by Townsend-Greenspan and Company, Economic Consultants, One New York Plaza, New York, N.Y., Oct. 1971.
Sales - 1958-1969 from Census of Manufacturers. 1970 estimated on basis of detailed price and volume data on packs of individual fruits and vegetables.

Almanac of Business and Industrial Financial Ratios, 1973, ed. Prentice-Hall

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Table 15 (continued)

Labor Cost - Payroll, 1958-1969 from Census of Manufactures. 1970 estimate from Bureau of Labor Statistics data. Fringe benefits, levels for 1957, 1967 and 1968, from 1958 Census of Manufactures and Annual Survey of Manufactures 1968. Other years estimated from data for SIC 20 in National Income Accounts.

Cost of Materials - Costs of fruits, vegetables and containers, Census of Manufactures for 1958, 1963 and 1967. Other years interpolated on basis of data in Tables 2 - 6. Other food ingredients, Census of Manufactures. Other materials, supplies, Census of Manufactures.

Depreciation - Based on data for SIC 203 from Internal Revenue Service, Corporation Source Books of Statistics of Income.

Profits - Profit margins derived from Touche Ross data for (1) a sample of California canners 1960-1968, and Northwest, East and Midwest canners for 1960-1964, and (2) a smaller sample of total company pretax margins for 1960-1970. Regional data were reweighted according to national totals from the Census of Manufactures and margin trends calculated using Census profit margin proxies (ratio of value added less payroll to total sales). Estimates for 1958 and 1959 were obtained by linking to data for SIC 203 from IRS Source Books.

All Other Costs - Derived as residual.

Table III-16. Net Income as a Per Cent of Equity

	(1) All Corporations	(2) Total Manufacturing	(3) Food & Kindred Products	(4) Canned & Frozen Foods	(5) Canning Industry Selected Group (1)
Annual averages:					
1959-61	5.9	6.8	7.3	8.0	n.a
1962-64	6.4	7.9	7.9	6.4	8.1a
1965-67	8.1	10.1	9.2	9.2	9.9
1968-70	n.a.	n.a.	n.a.	7.8	4.6

(1) Total company, including other seasonal and nonseasonal food products and certain foreign and other operations.

a - Average of 1963 and 1964

n.a. - Not available.

Source: National Canners Association as developed by Townsend-Greenspan and Company.
Cols. 1 through 4 - Internal Revenue Service, "Corporation Income Tax Returns."
Col. 5 - Touche Ross & Co. study of nine major fruit and vegetable canners.

In general, apparently the capital required for pollution control for large and medium size canners and, especially, freezers will be available; however, in individual situations where plants are old, obsolete, or unprofitable and where local conditions may require substantial investments for internal pollution abatement systems or for expanding the capacity of sewer systems in small communities, fruit and vegetable management may hesitate to make the investments required--even though capital may be available.

Capital availability may be a much mor serious problem for small plants which continue to operate primarily because owners have depreciated out original investment costs, consider their investment in the plant as "sunk capital" and consider that the plant has a "utility value" if continued in operation which is greater than the " market value" or "salvage value" of the plant should they decide to cease operations. For such plants, the increased investment required for pollution control may be difficult to obtain and, even if available, may be unattractive to both the borrower and the lender. In these situations, the decision to obtain additional capital may be based on the desire of the owners to maintain the business for reasons other than realizing a return on invested capital.

IV. PRICING EFFECTS

This chapter briefly explores the possible price effect of mandatory pollution abatement standards on the fruit and vegetable canning, freezing and dehydrating industries. Such a discussion can be broad and diverse, but here it will be confined to emphasizing the industry's pricing determinants and the effect on them of pollution control costs.

A. Price Determination

Although the fruit and vegetable processing industry is characterized by the existence of relatively few large multi-product, multi-plant firms processing a high proportion of the total industry output, the industry is nevertheless highly competitive. In addition, there are many small canners and freezers, and the industry must sell a high proportion of its total pack to large national food chains. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions. The effect of these characteristics dictates that prices are determined largely on a competitive basis under conditions of supply and demand. This chapter explores briefly these conditions.

1. Demand

The primary demand for processed fruits and vegetables--canned, frozen, dried or dehydrated--is a nation-wide market of consumers served mainly through retail food stores. Secondary, but nevertheless important, markets are institutional food purchases (hotels, restaurants, in-plant feeding, schools, etc.), governmental purchases for military consumption, school lunch and welfare subsistence programs, and purchases by secondary processors who use processed fruits and vegetables in the manufacture of prepared dinners and other convenience foods. For some products, mainly fruits, there exists an important export market.

Long-run changes in demand for processed fruits and vegetables are affected by gradual changes in dietary patterns, consumer preferences and by technological processes which increase the availability and convenience of these foods.

Short-run changes in demand are influenced by seasonal and year-to-year variations in production of fresh and processed fruits and vegetables. Carry-over stocks of canned and frozen products are important in relation to short-run demands, but in the long-run the entire pack of bothcanned and frozen products ultimately moves into consumption.

a. Aggregate Demand for Processed Fruits and Vegetables

Aggregate demand for processed fruits and vegetables can best be examined by (1) exploring trends in per capita consumption of major product groupings, (2) briefly looking at government purchases and international markets, and (3) examining total pack by major product lines. (To expedite discussion, an examination of carry-over stocks will not be made in this discussion; it is assumed that total pack represents consumption.)

b. Per Capita Consumption of Fruits and Vegetables

Some very distinct changes have occurred in the patterns of consumption of fruit and vegetables by the American consumer over the past two decades that can best be examined by viewing past utilization trends. Changes in consumption patterns generally reflect the interaction of various factors such as production, price, rising income, population, new food styles, and more casual and informal living.

Fruits - After a record high per capita consumption of all fruits in 1946 of 225 pounds (fresh equivalent)--partially the result of restocking pantry shelves and retail stores following the wartime scarcity--consumption leveled off to approximately 200 pounds in the early 50's. During the last two decades annual per capita consumption of all fruits combined fluctuated from a high of 203 pounds in 1952 to a low of 165 pounds in 1964. Present level is at about 200 pounds (fresh equivalent).

Total consumption of processed fruits (product weight basis) have increased steadily from 43 pounds per capita in 1950 to 55 pounds by 1971. According to USDA specialists, consumption will climb to about 60-61 pounds by 1980 (Table IV-1).

Canned fruits have consistantly averaged 23-24 pounds per capita during the past 10 years and are expected to hold at the present level through 1980.

Table IV -1. Processed fruits: per capita consumption, United States, 1929-71

Year	Canned fruits[1]	Canned juices[2]	Dried fruits[3]	Frozen fruits[4]	Total
	(lbs.)	(lbs.)	(lbs.)	(lbs.)	(lbs.)
1950	21.6	13.5	4.1	4.3	43.5
1951	19.0	15.0	3.8	4.8	42.6
1952	20.8	14.1	3.8	6.6	45.3
1953	21.0	13.4	3.8	7.1	45.3
1954	21.2	13.2	3.9	7.4	45.7
1955	22.5	12.0	3.6	8.7	49.8
1956	21.9	14.8	3.7	8.8	49.2
1957	22.6	15.6	3.6	9.0	50.8
1958	22.9	16.1	3.0	7.9	49.9
1959	22.3	14.0	3.2	8.8	48.3
1960	23.0	15.1	3.1	9.1	50.3
1961	23.6	13.4	3.1	8.8	48.9
1962	23.2	14.0	3.0	9.7	49.9
1963	23.3	14.2	2.9	8.0	48.4
1964	23.4	12.9	2.9	7.4	46.6
1965	23.8	12.9	3.0	8.5	48.2
1966	23.4	14.9	3.0	8.1	49.4
1967	23.1	16.1	2.8	10.1	52.1
1968	22.3	16.4	2.8	9.4	50.9
1969	24.6	18.9	2.7	9.3	55.5
1970	23.7	18.9	2.7	9.8	55.1
1971	22.2	20.2	2.6	10.2	55.2

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[1] Apples, applesauce, apricots, berries, cherries (including brined), cranberries, figs, fruit cocktail and salad, citrus sections, olives (including brined), pineapple, plums, prunes, peaches (including spiced), and pears.

[2] Grapefruit, orange, blended citrus, lemon and lime, tangerine and blends, pineapple, apple, grape, and prune juices, and fruit nectars. Including canned concentrated citrus juices converted to single-strength basis but excludes all frozen juices.

[3] Dried apples, apricots, dates, figs, peaches, pears, prunes, and raisins. Excludes unmerchantable figs, substandard prunes, and prunes used for juice and concentrate. Data are in terms of processed dried weight.

[4] Principally cherries, apples, peaches, apricots, strawberries, other berries, and citrus juices.

Dried fruits have steadily declined in importance from 1950 dropping from 4.1 pounds per capita on a processed dried weight basis to 2.6 pounds in 1971. This includes dried apples, apricots, dates, figs, peaches, pears, prunes and raisins.

Frozen fruits (including frozen citrus juices) have also increased steadily from 4.3 pounds in 1950 to approximately 10 pounds per capita during the past five years. This can be expected to increase slightly to approximately 12 pounds per capita by 1980.

Vegetables - The consumption of vegetables (fresh equivalent)[1/] has increased gradually over the past 20 years from about 200 pounds per capita to the present rate of consumption of about 210 pounds (Table IV-2). Future consumption is not projected to change drastically with total per capita consumption in 1980 projected to be about 215-220 pounds.

During this time a gradual increase in the consumption of canned and frozen vegetables has occurred. Since total consumption did not appreciably change, this increase has been at the expense of the fresh product share of the market. The convenience of using processed products and their comparable quality and price have stimulated increases in the consumption of both frozen and canned vegetables.

Canned vegetable consumption climbed from 77 pounds per capita in 1950 to 94 pounds in 1969 where it held through 1971. At the same time, frozen consumption climbed steadily from the early 1950's to nearly 20 pounds in 1971. Fresh consumption, however, decreased from about 115 pounds in 1950 to 105 pounds in 1960. Further decline has placed per capita fresh consumption at about 98 pounds for the past five years.

USDA specialists believe that the major shift from fresh to canned and frozen has leveled out despite the anticipated increase in total canned and frozen consumption from the current 114 pounds per capita to about 120 by 1980. This will not be at the expense of fresh produce; it will reflect, rather, an increase in total consumption. Most of this gain will be taken up by frozen commodities which should increase to about 24 pounds by 1980. Fresh vegetables are projected to remain at the same level for the remainder of the decade.

[1/] The canned and frozen consumption estimates are based on the commonly used "fresh equivalent basis." This means that the 94 pounds of canned (fresh equivalent) reported for 1969 would actually amount to 51 pounds of consumption (about 54 percent). For frozen vegetables it would amount to about 9 pounds of actual consumption for 20 pounds of fresh equivalent (44 percent).

Table IV-2. Commercially produced vegetables: Per capita consumption, United States, 1950-71

Year	Total fresh and processed	Fresh[1]	Processed		
			Total	Canned	Frozen
	(lbs.)	(lbs.)	(lbs.)	(lbs.)	(lbs.)
1950	199.2	115.2	84.0	76.6	7.4
1951	200.8	111.9	88.9	79.6	9.3
1952	199.7	111.6	88.1	76.8	11.3
1953	200.2	109.1	91.1	79.4	11.7
1954	196.2	107.2	89.0	76.8	12.2
1955	198.5	105.2	93.3	80.2	13.1
1956	201.5	107.0	94.5	80.9	13.6
1957	201.0	106.4	94.6	80.6	14.0
1958	199.9	103.7	96.2	81.5	14.7
1959	198.4	102.3	96.1	81.2	14.9
1960	202.5	105.9	96.6	81.7	14.9
1961	199.9	103.8	96.1	81.3	14.8
1962	201.12	101.4	99.7	83.7	16.0
1963	201.7	101.4	100.3	84.9	15.4
1964	198.5	98.6	99.9	83.7	16.2
1965	201.3	98.6	102.7	85.3	17.4
1966	201.7	96.0	105.7	86.8	18.9
1967	209.2	98.1	111.1	9[illegible].2	19.9
1968	212.3	98.7	113.6	92.6	21.0
1969	213.0	98.9	114.1	94.6	19.5
1970	213.7	98.9	114.8	93.9	20.9-
1971[2]	210.7	97.3	113.4	94.0	19.4

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[1] Excludes melons. Data include pickles and sauerkraut in bulk; excludes canned and frozen potatoes, canned sweetpotatoes, canned baby foods, and canned soups.

[2] Preliminary.

Potatoes - The above data exclude the consumption of processed potatoes. Demand for potatoes and potato products has changed markedly during the past decade. Annual per capita consumption (fresh and processed combined on a fresh weight equivalent basis) rose from 108.4 pounds in 1960 to 118.4 pounds in 1970. The increase is credited entirely to processed use, which rose from 24 pounds in 1960 to 59 pounds in 1970. In contrast, fresh per capita potato consumption fell from 85 to 60 pounds.

Among the processed potato products, frozen French fries consumption has increased the most. In 1960, people ate less than 7 pounds (fresh eight equivalent) of frozen processed potatoes.. Ten years later they ate 28 pounds (nearly half of all potatoes processed) compared with only 28 percent in 1960. Further gains in the use of frozen French fries have occurred since 1970. A preliminary estimate of per capita consumption showed 32.5 pounds per person in 1972.

Chips increased from 11.6 to 17.7 pounds but took approximately 50 percent of all processed potatoes in the early 1960's compared to 30 percent in 1970. Per capita use of dehydrated potatoes moved upward enough to have a significant impact on total processed usage. Dehydrated potatoes accounted for about a fifth of all potatoes used for processing in most years. Per capita consumption rose from 5 pounds to 13 pounds. Per capita use of canned potatoes was minor at less than 1 pound throughout the period.

Several factors are behind these changes in per capita consumption. Retail price trends have encouraged the shift to processed potatoes, especially frozen. Prices of fresh potatoes increased from 71.8 cents for 10 pounds in 1960 to 89.7 cents in 1970. Retail prices of frozen French fries declined from 19.7 cents for 9 ounces in 1960 to 16.6 in 1970.

Other factors include shifts in consumer tastes and preferences because of changing living patterns, an increase in the number of working wives, and a desire for more convenience. Processed potatoes are essentially convenient and time-saving foods. Also, frozen and dehydrated potato products are popular for institutional trade, i.e., the away-from-home trade where convenience, uniformity, quality and portion control are important.

c. International Trade

Exports - Although there is an appreciable year-to-year variation in the export of individual fruits and vegetables, little trend is apparent over the last five years in U. S. exports of canned and frozen fruit, vegetable and juice products. The following data indicate the export volumes for general product categories, 1967-1971.

Products	Unit	Export Volume				
		1967	1968	1969	1970	1971
Canned fruits	(000 lbs)	354,809	302,234	439,990	396,261	321,850
Canned vegetables	(000 lbs)	100,261	89,764	107,384	102,587	84,717
Canned juice	(000 gal)	33,115	29,992	28,199	32,135	28,516
Frozen juices	(000 gal)	5,419	5,162	5,437	7,815	9,641
Frozen fruits & veg.	(000 lbs)	32,377	32,276	34,351	30,342	24,036

These data do show the dominance of canned fruits in the export trade. While the pack of canned vegetables in the United States is approximately twice that of canned fruits, exports of canned fruits equal approximately three times the volume of canned vegetables.

Exports of canned vegetables, fruits and juices are shown in Table IV-3 for 1970 and 1971. As can be seen, exports of canned vegetables are not significant, in terms of total pack, for any item. Canada is the major export market for most products, although Japan is first for sweet corn and Hong Kong is an important market for both corn and tomato catsup.

The situation is different for canned fruits. Export markets are relatively important, taking 14.7 percent of the fruit cocktail pack, 14.5 percent of the cherry pack, 12.6 percent of the peach pack, and 9.1 percent of the pineapple pack for 1970. West Germany and other Western Euorpean countries and Canada are the major export markets for canned fruit products.

Much the same situation exists for canned fruit juices. Export markets take 41.5 percent of the hot-pack orange juice. The U. S. market has turned largely toward frozen concentrated orange juice, but there is still a good market for hot-pack juice in Canada, Western Europe and Sweden. A good export market (13.5 percent of total pack) also exists for canned grapefruit juice and 9.8 percent of the pack of canned pineapple juice is exported. In contrast, only 2.8 percent of the pack of canned tomato juice is exported.

Table IV-3. Exports of major canned and frozen vegetables, fruits and juices, 1970 and 1971

Product	1970	1971	% of Pack	Major Countries
	(000 lbs)		(1970)	
Canned vegetables				
Tomatoes	19,146	17,381	2.4	Canada
Corn	15,574	14,740	1.3	Japan Hong Kong Denmark Sweden W. Germany France Nigeria Switzerland
Tomato puree and conc.	9,994	6,801	4.1	United Kingdom Canada
Beans, nec	7,638	3,123	0.7	Dominican Republic Panama Canada
Asparagus	7,486	4,484	4.4	Denmark Sweden Belgium-Lux. W. Germany United Kingdom
Tom. catsup and Chili sauce	6,967	10,576	0.7	Hong Kong Canada
Other	35,782	27,612	-	
Total Canned Veget Vegetables	102,587	84,717	-	
Frozen vegetables (all)	25,798	17,905	0.6	Canada United Kingdom Denmark Sweden Bermuda Australia W. Germany

Table IV -3. Exports of major canned and frozen vegetables, fruits and juices, 1970 and 1971 (continued)

Product	1970	1971	% of Pack	Major Countries
	(000 lbs)		(1970)	
Canned fruits				
Peaches	165,573	137,811	12.6	W. Germany Canada Switzerland Belgium-Lux. Sweden Netherlands Austria
Fruit cocktail	108,773	76,832	14.7	Canada W. Germany Belgium-Lux.
Pineapple	68,648	63,321		W. Germany Belgium-Lux. France Canada Netherlands Switzerland
Cherries	3,301	3,192	3.1	W. Germany Belgium-Lux. Netherlands Rep. South Africa
Pears	8,743	10,109	2.1	W. Germany Canada
Other	41,223	30,585	-	
Total Canned Fruits	396,261	321,850	-	
Canned juices				
Pineapple	3,749	3,051	9.8	Canada
Grapefruit, single strength	5,990	4,940	18.5	Canada
Orange, single str. and conc.	12,632	10,303	41.5	Canada Sweden France W. Germany

Table IV-3. Exports of major canned and frozen vegetables, fruits and juices, 1970 and 1971 (continued)

Product	1970	1971	% of Pack	Major Countries
	(000 lbs)		(1970)	
Canned juices (continued)				
Tomato	1,589	1,461	2.8	Japan Saudi Arabia Canada
Other	8,175	8,701	-	
Total canned juices	32,135	28,516	-	
Frozen juices				
Orange, froz. conc.	6,097	7,839	5.6	Canada Sweden United Kingdom W. Germany
Grapefruit, froz. conc.	939	998	15.9	Canada Australia W. Germany

Frozen concentrated orange juice is the principal frozen product exported. Over six million gallons (60 million pounds) were exported in 1970, and nearly eight million gallons in 1971, a volume greater than all other frozen fruit, vegetable and juice products. Canada, Sweden, United Kingdom, and West Germany were the principal export markets served. In terms of total U. S. pack, exports of frozen, concentrated orange juice accounted for only 5.6 percent of total pack.

The export market for frozen concentrated grapefruit juice, while smaller than for orange juice (998,000 gallons), accounted for 16 percent of total pack in 1971.

Exports of frozen vegetables in 1970 were 25,798,000 pounds, only 0.6 percent of total pack.

While exports of canned and frozen fruit, vegetable and juice products were valued at over $143,000,000 in 1970, they still represent but a small percentage of the total pack of these products. There are individually important exports, however: canned, hot-pack orange and grapefruit juice, canned cherries, fruit cocktail, and peaches. For most fruits, vegetables and juices, either canned or frozen, the private, domestic market is still the dominant outlet.

Imports - The greatest competition with regard to imports of fruits and vegetables is from the importation of fresh products. Imports of processed fruits, vegetables and juices are primarily those of tropical or subtropical products not produced in the United States. Certain product imports, however, do constitute a major part of the total supply in the United States and do, therefore, compete directly with similar products processed by U. S. canners and freezers.

Imports of these products -- volume, relation to U. S. pack and principal countries of origin -- are shown in Table IV-4.

Imports of apple and pear juice, mainly from Switzerland and France, in 1970 totaled 16.8 million gallons -- equal to 45 percent of the U. S. pack. This doubled in 1971 to 34.0 million gallons.

Pineapple juice imports in 1970, 13.6 million gallons, were equal to 38 percent of the U. S. pack. Most of this import volume came from the Philippines. Canned pineapples imported from the Philippines, Taiwan, Mexico, Malaysia and Thailand equaled 32 percent of the U. S. pack.

Table IV-4. United States' imports of canned and frozen fruit and vegetable products, 1970 and 1971

Product	Unit	1970	1971	% of U. S. Pack (1970)	Principal Countries of Origin
Canned Fruit Juices					
Apple and pear juice	000 gal.	16,900	34,024	45	Switzerland France Austria
Orange juice, conc.	000 gal.	1,461	19,343	15	Brazil
Pineapple juice	000 gal.	13,595	13,143	35	Philippines
Canned & Froz. Fruits					
Blueberries, frozen	000 lbs.	11,099	8,433	29	Canada
Pineapples, canned	000 lbs.	239,773	259,685	32	Philippines Taiwan Mexico Malaysia Thailand
Strawberries, frozen	000 lbs.	109,738	84,565	61	Mexico
Canned Vegetables					
Tomatoes, paste & sauce	000 lbs.	91,382	97,817	8	Portugal
Tomatoes, except paste	000 lbs.	128,534	108,557	16	Italy Spain
Mushrooms, prep. pres. except dried	000 lbs.	24,808	30,763	50	Taiwan

Orange juice concentrate increased sharply from 1.5 million gallons in 1970 to 19.3 million gallons in 1971 or 15% of the U. S. pack.

Canada was a major supplier of frozen blueberries, equal to 25 percent of the U. S. pack, and Mexico exported nearly 84 million pounds of frozen strawberries to the United States, an amount equal to 46 percent of the U. S. pack in 1971.

Large quantities of canned mushrooms, nearly 31 million pounds, are received from Taiwan -- equal to 60 percent of the U. S. pack.

Nearly 200 million pounds of tomatoes, paste and sauce, came into the United States in 1970, mainly from Italy, Portugal and Spain.

Although imports of canned and frozen fruits, vegetables and juices are relatively minor when compared to the total U. S. pack of these products, imports are important in competition with certain products. Most important are:

1. Frozen strawberries
2. Canned mushrooms
3. Canned apple and pear juice
4. Canned pineapple juice
5. Canned pineapple
6. Frozen blueberries.

d. Government Purchases

Government purchases of canned and frozen fruits, vegetables and juices are made primarily to supply the requirements of the Armed Services, Veterans Administration, School Lunch Program and Needy Families Programs.

Canned Products - Although the volume of purchases varies substantially from year to year for specific canned fruit or vegetable items, there has been no consistent trend in the volume of government purchases (either up or down) for individual items or aggregate volume during the period 1966-1971. Total government purchases of canned products during the past five years were as follows:

Year	All Vegetables 000/Cases 24/303	All Fruits 000/Cases 23/2 1/2	All Juices 000/Cases 24/2
1966	16,437	6,337	4,409
1967	16,355	9,621	9,101
1968	12,475	5,300	3,272
1969	18,302	5,574	8,218
1970	13,167	7,142	8,050
1971	11,126	6,590	7,892

The principal canned vegetables purchased in volume were tomatoes and tomato paste, green beans and sweet corn. In relation to total pack, government purchases of canned vegetables varied between a low of 1.6 percent for sauerkraut and a high of 8.2 percent for tomatoes and tomato paste.

Only two canned fruits were purchased in large volumes -- peaches and applesauce. In relation to total pack, government purchases varied from a low of 1.9 percent for fruit cocktail to 7.8 percent of the total apricot pack.

Government purchases of canned juices were relatively more important in relation to total volume packed, accounting for 12.8 percent of the pack of apple juice, 11.8 percent of the pineapple juice, and 11.4 percent of the canned orange juice pack.

In summary, government purchases of canned fruit and vegetable products, though important in total market demand, are not dominant.

Frozen Products - There was an increasing trend in military purchases of frozen vegetables. Its volume increased from 67,981,000 pounds in 1966 to 83,865,000 in 1970, but it declined to 73,260,000 in 1971. The increase was essentially for frozen potato items; however, the trend appears to be decreasing for other frozen vegetables and frozen fruits and juices. Total government purchases of frozen vegetable, fruit and juice products during the past six years were as follows:

Year	Frozen Vegetables (000 lbs.)	Frozen Fruits (000 lbs.)	Frozen Juices (000 lbs.)
1966	67,981	24,895	24,460
1967	79,241	25,930	24,334
1968	72,592	23,883	18,750
1969	80,270	20,588	20,962
1970	83,865	19,227	18,321
1971	73,260	14,709	13,922

Potato products represent the greatest total volume, over 24 million pounds, of frozen vegetables but even so, government purchases represent only one percent of the total frozen pack of potato products. Other large volume items are mixed vegetables, green beans, peas, corn and broccoli. In terms of relative importance, government purchases were most significant for mixed vegetables (8.9% of pack), Brussels sprouts (7.2%), asparagus (6.8%) and cauliflower (6.7%) in 1970.

Principal frozen fruits purchased in 1971 were strawberries at 5.4 million pounds and peaches at 5.1 million pounds. Peaches were the only crop for which government purchases (12.5%) were a major part of the total sales.

Frozen concentrated orange juice goes mainly to the military subsistence and school lunch programs. Government purchases in 1971 were 8.9 million pounds, but this represented but 1.0 percent of the total pack of frozen concentrated orange juice.

In summary, as was true for government purchases of canned vegetables, fruits and juices, government purchases represent substantial product volumes for frozen products, but are not dominant in relation to total sales for specific products or volume in total.

e. Total Demand by Commodity

Although there is normally some carry-over from one packing season to the next, the total volume packed is the best indicator of aggregate demand for specific products.

Canned Vegetables - Table IV-5 shows the total packs for canned vegetable commodities for the 1969-70, 1970-71, and 1971-72 pack seasons. Total canned vegetable pack in the 1969-70 pack year season was 326,474 thousand cases; for 1970-71, 324,850 thousand cases, and for 1971-72 an estimated 344,608 thousand cases. While there has been a slight increase during the past few years, the demand is relatively constant with slight increases due primarily to population increases.

Canned Fruits of Fruit Juices - Table IV-6 shows the total pack for canned fruits and fruit juices for 1969, 1970 and 1971 pack season. Total pack of canned fruits and fruit juices for 1969 was 232,084,000 actual cases and 205,130,000 actual cases in 1970. Estimated canned fruit and fruit juice packs for the 1971-72 pack season are 205,972,000 actual cases. These packs compare with an average pack of 199,580,000 cases during the 1961-70 period.

Frozen Vegetables - Table IV-7 shows the total pack of frozen vegetables for 1969, 1970 and 1971. The pack for 1970 was 4,472,213,000 pounds, more than double the pack in 1961 (2,116,041,000 pounds) and nearly 50 percent above the 1961-70 average (3,123,665,000) pounds.) 1971 pack statistics show an increase over the 1970 production levels with 4,697,787,000 estimated pounds.

Table IV-5. Summary of canned vegetable packs, 1969, 1970 and 1971[1]

Product	Pack, 000 Cases 24/303 cans 1969-70	1970-71	Estimated 1971-72
Tomatoes & Tomato products - Total	112,148	120,200	124,182
Tomatoes, whole peeled	32,036	39,017	38,385
Tomato juice	33,653	35,952	38,411
Tomato catsup	37,780[2]	37,780[2]	37,780[2]
Tomato chili sauce	1,665	1,504	1,462
Tomato puree	7,014	5,947	7,844
Corn, Sweet	49,387	46,995	53,757
Beans, Green	42,481	43,189	45,213
Peas, Green	32,071	28,697	33,197
Potatoes, Sweet	12,499	9,846	9,846[3]
Beets	11,339	11,310	11,310[3]
Sauerkraut	10,569	12,088	12,088[3]
Asparagus	6,817	5,972	5,542
Spinach	6,577	7,270	7,675
Potatoes, White	6,110	6,602	6,602[3]
Carrots	5,463	5,388	5,388[3]
Pumpkin and Squash	5,244	3,973	4,581
Beans, Wax	4,858	4,382	4,797
Mixed Vegetables	4,357	4,367	4,482
Beans, Lima	3,596	2,776	3,116
Leafy greens	3,440	3,527	4,443
Peas, field	2,946	2,393	2,742
Carrot and Peas	2,438	2,086	2,106
Mushrooms	2,032[4]	2,032[4]	2,032[4]
Pimentos	876	627	738
Okra and tomatoes	475	348	378
Succotash	383	339	338
Okra	368	443	355
Total	326,474	324,850	344,608

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[1] Source: Division of Statistics, National Canners Association

[2] 1967 pack, data not available since that time

[3] 1970 pack, data not available for 1971-72.

[4] 1968 pack, data not available for 1969, 1970 or 1971-72.

Table IV-6. Summary of canned fruit and fruit juice pack 1969, 1970 and 1971[1]

Product	Pack, 000 Actual Cases 1969	1970	1971
Peaches	43,645	33,096	29,885
Apple Sauce	27,553	23,647	23,647[2]
Pineapple	24,256	25,939	25,939[2]
Fruit Cocktail	23,909	18,319	19,141
Grapefruit Juice	20,080	23,854	23,854[2]
Orange Juice	17,082	17,080	16,966
Pears	13,597	10,906	13,284
Pineapple Juice	13,558	12,387	12,387[2]
Apple Juice	13,503	14,472	14,472[2]
Apricots	7,126	4,654	4,182
Cranberry Sauce	6,692	7,394	6,551
Grapefruit Segments	3,726	3,629	3,629[2]
Apples	3,128	2,271	2,271[2]
Other Fruits and Juices	14,229	10,860	9,764
Total	232,084	205,130	205,972

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[1] Source: Division of Statistics, National Canners Association

[2] 1969-70 pack, 1971-72 data not yet available

In terms of total tonnage produced, potato products represent over half of the total volume 2.4 billion pounds in 1970 out of a total pack of 4.5 billion pounds. Other major frozen vegetables included:

peas	344 million lbs.	7.7% of pack
corn, cut	216 million lbs.	4.8% of pack
beans	212 million lbs.	4.7% of pack

In addition, broccoli, carrots, and spinach were important though less so.

Frozen Fruits and Fruit Juices - Frozen fruits and fruit juices do not show the consistent upward trend in volume that exists for frozen vegetables (Table IV-8).

Four products dominate the pack of frozen fruits and juices. Frozen concentrated orange juice pack is more than equal to the entire pack of all other frozen fruits and juices, amounting in 1970 to 126,402,000 gallons for 1,251,379,000 pounds out of a total pack of 620,688,000 pounds for all other frozen fruits. Among frozen fruits, strawberries--201.6 million pounds (32 percent of total frozen fruit pack) is by far the dominant product. Other important frozen fruits are cherries and apples and apple sauce.

f. Expenditure Proportions

To this point, the discussion of demand has been confined to considering such measures as total demand by product group, total demand by specific commodity or per capita consumption levels. One factor that has not been considered is retail expenditure proportions. The importance of canned and frozen fruits and vegetables as a portion of total expenditures or as a proportion of food expenditures is briefly discussed below. Table IV-9 presents expenditure proportions for canned and frozen fruits and vegetables relative to total retail expenditure and retail food expenditures.

Fruit and Vegetable Expenditures as a Proportion of Total Retail Expenditures - Expenditures for fresh, canned, frozen and dried fruits and vegetables comprise only 4.7 percent of total retail expenditures. If, however, fresh sales are deleted the proportion attributed to processed fruits and vegetables falls to less than 2 percent of retail sales. This includes canned, frozen and dehydrated fruit and vegetable products which contribute 1.19, .34 and 0.1 percent respectively.

Table IV-8. Summary of frozen fruit and fruit juice packs, 1969, 1970 and 1971[1]

Product	Pack (000 lbs.)		
	1969	1970	1971
Strawberries	178,693	201,572	199,399
Cherries RSP	140,688	121,271	159,408
Apples and sauce	122,293	100,370	96,999
Orange Juice, conc.	108,043[2]	126,402[2]	125,187
Peaches	53,527	47,471	59,924
Blueberries	37,663	21,836	30,441
Raspberries, red	27,657	25,409	24,467
Blackberries	27,184	29,186	27,536
Other fruits, berries and juices	90,578	73,573	67,304
Total	678,283	620,688	665,478

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[1] Source: American Frozen Food Institute

[2] Thousands of gallons, not included in pack totals,
equals 1,069,625,000 lbs. 1969
1,251,379,000 lbs. 1970

Table IV-9. Fruit and vegetable as a proportion of retail food and total expenditures

Commodity	Proportions expressed as a percentage of: Food expenditure	All expenditure
Fruit		
Fresh	4.846	1.1045
Canned	.217	.5053
Frozen	.746	.1700
Dried	.373	.0850
Total Fruit	8.182	1.8648
Vegetables		
Fresh	4.265	.9721
Canned	3.002	.6842
Frozen	.746	.1700
Dried	.373	.0850
Total vegetables	8.386	1.9113
Potatoes		
White	1.226	.2795
Sweet	.174	.0399
Total Potatoes	1.401	.3194
Total all food	100.00	22.79
Total nonfood		77.21

Source: George and King, Consumer Demand for Food Processing, 1971.

Fruit and Vegetable Expenditures as a Proportion of Food Expenditures - The relative size or importance of canned, frozen, and dehydrated fruits and vegetables relative to total food expenditures is also presented in Table IV-9. Expenditures for fruit and vegetables (exclusive of potatoes) comprise 8.1 and 8.3 percent of all retail food expenditures respectively.

More than half of this amount is for fresh products with the remainder divided among canners (3.2 percent), freezers (1.5) and dehydrators (.75 percent).

Substitute Products - The principal substitutes for canned and frozen fruits, vegetables and juices are fresh fruits and vegetables. Although fresh products substitute for both canned and frozen forms of the same product, the substitution relationship between the fresh and frozen product is usually closer since the canned product is often cooked and may have seasoning (salt, etc.) or sweetness (e.g., peaches in heavy syrup) added.

The development of new fresh production areas, improvements of truck, rail, and air transport, new technology in fresh product preparation, packaging and refrigeration have now made it possible to buy fresh products nearly the year around throughout the United States. Because, however, out-of-season fresh products must be transported greater distances (i.e., Mexico, Central or South America), or must be produced under hot house conditions in colder climates, prices have risen and consumers have turned increasingly to frozen or canned forms. But price is not the only consideration influencing the consumers in their choice between fresh and processed fruits and vegetables. Many canned or frozen products offer greater convenience, more consistent quality, and preferred flavor for certain uses. Canned and frozen products are easier to keep on hand on the shelf or in the freezer, and this gives the housewife a greater variety available in her home at any given time than would be possible if she were entirely dependent on fresh products.

There are some substitution relationships between canned and frozen vegetables and other classes of foods. Canned or frozen fruit can, and does, substitute as a dessert for such items as ice cream, cakes or puddings. As dietary havits have changed (away from fats, oils, and heavy desserts), there has been some substitution of fruits and vegetables. However, this relationship is not close.

Retail Price Elasticity - Retail price elasticity measures the responsiveness of demand to price changes. In a study by Brandow of Pennsylvania State University [1] the price elasticity of all fruits is identified as -.60, and for all vegetables at -.30.

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[1] Brandow, G. E., Interrelations Among Demands for Farm Products and Implications for Control of Market Supply, Bulletin No. 680, Pennsylvania State University, 1961.

Table IV-10 presents retail demand elasticities, cross-elasticities and income elasticities for a variety of canned, and frozen fruit and vegetable products. Additional elasticities have been estimated in the above reference but have not been included herein.

d. Price Margin and Price Conditions for Selected Products

There is a considerable variation in prices, margins, and farm value for processed fruits and vegetables. Most of the variation and fluctuations occur from one marketing year to another with moderated fluctuations and variations within the marketing year. Retail prices and retail and wholesale margins chacteristically fluctuate more frequently and with greater amplitude than do processor and grower prices and processor margins.

Retail prices, processor prices, farm values, and total marketing margins have increased during the past few years. As a percentage of retail prices, however, farm value and marketing margin have been relatively constant. Price fluctuations have normally been shared by both the grower and the retail and wholesale marketing system. One noteable exception is citrus prices received by the grower which have fluctuated widely.

Retail prices, processor prices, farm values, and processor margins associated with canned peaches, canned pears and frozen strawberries have not increased in recent years.

Table IV-11 and IV-12 present prices and margins for a variety of selected fruit and vegetable products.

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[1] George, P.S. and G.A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980, California Agricultural Experiment Station, 1971.

Table IV-10. Selected fruit and vegetable demand and income elasticities

	Frozen Fruits	Dried Fruits	Selected Canned Fruits		Frozen Vege.	Dried Vege.	Selected Canned Vegetables			Other Canned Fruits & Vege.	Income
			Peaches	Pine-apple			Corn	Tomatoes	Peas		
Frozen Fruits	-1.0	.003	.013	.0005	.0009	.001	.002	.001	.002	.009	.147
Dried Fruits	.0079	.65	.106	.0001	.0001	.0001	.0003	.0001	.0003	.0003	.661
Selected Canned Fruits:											
Peaches	.0184	.0641	-.759	.125	.0004	.0005	.0009	.0005	.001	.001	.447
Pineapples	.0011	.0000	.155	-.826	.00002	.00003	.00006	.00003	.00007	.00007	.315
Frozen Vegetables	.001	-.0001	-.00004	.000005	-1.03	.007	.010	.007	.012	.002	.616
Dried Vegetables	.003	.0002	.001	.0003	.015	-.48	.078	.00000	.024	.0003	.216
Selected Canned Vege:											
Corn	.004	.00006	.001	.0005	.016	.059	-.255	.00001	.059	.003	.173
Tomatoes	.003	.0003	.001	.0003	.015	.00003	.00000	-.176	.056	.001	.216
Peas	.0005	.00006	.001	.0005	.016	.014	.047	.033	-.185	.003	.023
Other Canned Fruits & Vegetables	.003	.0001	.001	.0003	.015	.0004	.0004	.0002	.0006	-.40	.200

Table IV-11. Growers, processors, and wholesaler-retail margins as a percentage of retail price - fruits

	Year	Grower	Processor	Wholesale Retail	Total
Applesauce	65-66	19	49	32	100
Canned	66-67	21	53	26	100
(Eastern Retail	67-68	24	53	23	100
Prices, Eastern	68-69	23	47	30	100
Growers	69-70	19	49	32	100
Grapefruit Sections	65-66	17	31	52	100
Canned	66-67	14	30	56	100
Eastern Retail	67-68	21	27	52	100
Southern Production	68-69	15	29	56	100
	69-70	16	29	55	100
Grapefruit Juice	65-66	28	38	34	100
Canned	66-67	19	37	44	100
Eastern Retail	67-68	32	28	40	100
Southern Production	68-69	22	35	43	100
	69-70	31	26	43	100
Lemonade frozen	65-66	14	40	46	100
U.S. retail	66-67	15	36	49	100
Western Production	67-68	17	35	48	100
	68-69	16	36	48	100
	69-70	14	37	49	100
Orange juice canned	65-66	25	40	35	100
Eastern retail	66-67	19	37	44	100
Southern production	67-68	35	29	36	100
	68-69	34	29	37	100
	69-70	26	38	36	100

Table IV-11. (continued)

	Year	Grower	Processor	Wholesale Retail	Total
Orange juice frozen Concentrated U.S. retail Southern production	65-66	40	34	26	100
	66-67	26	34	40	100
	67-68	43	29	28	100
	68-69	46	31	23	100
	69-70	35	34	31	100

Table IV-12.Growers, processors, and wholesaler-retail, margins as a percentage of retail price - vegetable

	Year	Grower	Processor	Wholesale Retail	Total
Asparagus canned	65-66	30	29	41	100
Eastern retail	66-67	31	29	40	100
Eastern production	67-68	32	29	39	100
	68-69	31	33	36	100
	69-70	31	31	38	100
Asparagus canned	65-66	33	26	41	100
Western retail	66-67	36	25	39	100
Western production	67-68	32	27	41	100
	68-69	31	30	39	100
	69-70	31	30	39	100
Asparagus frozen	65-66	31	41	28	100
Western retail	66-67	35	37	28	100
Western production	67-68	33	37	30	100
	68-69	31	41	28	100
	69-70	31	41	28	100
Spinach canned	65-66	8	38	54	100
Eastern retail	66-67	8	37	55	100
Eastern production	67-68	8	37	55	100
	68-69	7	42	51	100
	69-70	7	46	47	100
Spinach canned	65-66	7	41	52	100
Western retail	66-67	7	40	53	100
Western producer	67-68	7	38	55	100
	68-69	7	43	50	100
	69-70	7	43	50	100

Table IV-12.(continued)

	Year	Grower	Processor	Wholesale Retail	Total
Spinach frozen Western retail Western production	65-66	8	58	34	100
	66-67	9	56	35	100
	67-68	8	59	33	100
	68-69	8	61	31	100
	69-70	8	55	37	100

2. Supply Characteristics of the Fruit and Vegetable Industry

The fruit and vegetable canning, freezing, and dehydrating industries are supply-oriented, that is, the location of processing plants is dictated by the location of raw product production. Most fruits and vegetables are perishable or semi-perishable and for most products, the time-lag between harvesting and processing must be kept to a minimum to maintain high standards of product quality.

The diversity of products processed and the seasonal production requirements of basic fruit and vegetable crops result in a widespread network of canning and freezing plants. Specific fruit or vegetable crops may be produced in more than one area at different seasons of the year.

Although a relatively small number of firms produces a relatively large percentage of the total pack, the production of these large, diversified packers is obtained from a large number of plants scattered throughout the principal producing areas. Although there is an appreciable concentration of capacity in a few firms, processing plants are widely dispersed.

Partly as the result of shifts in the relative importance of raw product production areas, there is some lack of balance in capacity and utilization of capacity of processing facilities.

The industry utilizes large numbers of relatively low-skilled production workers, especially women; however, it does require a highly skilled technical, quality-control, and managerial staff.

Production technology has changed substantially in recent years, and plant obsolescence is important, especially among small independent packers. There are appreciable economies of scale in production, and resultingly, a continuing decrease in the number of operating plants. -

a. Types and Locations of Raw Materials

The fruit and vegetable canning and freezing industries are primarily located near supplies of the fruits and vegetables processed. Other materials used, such as sugar, seasonings, cans, cartons, etc. are important, but the raw product tonnage required and the perishable nature of fruits and vegetables make the location of raw materials of paramount importance.

Though the diversity of products is such that plants are found in virtually every state (some Midwestern states have but a very few), a general characteristic of the processing industry shows that plants usually locate near product growing regions. The locating of potato processors in Oregon and Idaho is, for instance, typical.

Too, there is a tendency toward geographical clustering by processing or marketing types. Dehydration, for example, is heavily concentrated in Western states because only specialized products are dehydrated; apple production areas, on the other hand, tend to specialize by use or marketing type, i.e., the Pacific Northwest produces large quantities of apples for the fresh apple market, while Eastern apple producing states specialize in the production of apples for processing.

Mandatory industry pollution abatement standards can, therefore, be expected to adversely and disproportionately affect selected areas of the country.

b. Utilization of Plant Capacity

One important cost consideration is that fruit and vegetable plants are currently operating at a level of less than full capacity. This important cost or supply factor was simulated in the study's model plant data by variable cash flows that were developed for representative plants operating at 100 percent and 90 percent of plant capacity. Because the throughputs used are representative of actual average size, throughputs, plant sizes, and operating costs were adjusted upwards to represent, for example, a large sized plant operating at 90 percent capacity.

The economic implications of plant capacity and the effects of pollution abatement standards at various capacity levels were reflected by the above procedures. The effects of plant utilization on return on invested capital were demonstrated in an earlier study. For the small plant, returns were reduced from 14 percent to 7 percent when capacity utilization was reduced from 100 percent to 75 percent. Similar results were obtained for the medium sized plant with the internal rate of returns decreasing from 26 to 18 percent; for the large plant, returns dropped from 70 to 50 percent. Returns with treatment facilities were then reduced by about 7 percentage points for the small and medium sized plants and about 15 percentage points for the large plant.

c. Length of Operating Season

Another critical supply or cost consideration in the fruit and vegetable processing industry is length of operating season. Because raw product availability is limited to specific short seasons, a single-line plant may operate for as little as two months. Other multiproduct firms may operate for as long as nine months or more. With secondary processing, the plant may be operated on nearly a year-around basis.

Much effort is made to extend the annual operating season by hauling raw product from the South early in the year and/or hauling from the North late in the season. By processing a variety of products, the season may be extended. Also by operating on a two-shift per day basis--or even three--the effect of a longer season is obtained.

3. Pricing

a. Market Competition and Price Determination

Although the fruit and vegetable canning and freezing industries are characterized by the existence of large, multiproduct, multi-plant firms, where a relatively small number of firms process a high proportion of the total output, the industry is nevertheless highly competitive. There are a large number of small canners and freezers, and the industry is faced with the necessity of selling a high proportion of its total pack to large national food chains. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions.

Market information on current packs, carryover stocks and current prices is readily available so that all segments of the industry operate from a position of reasonable knowledge of market conditions.

Products are relatively standardized and are bought and sold by grade. Once a canning season is underway and prices have found the level dictated, in part, by supply conditions and known pack and stocks, prices are relatively stable as compared to those of many other industries.

Because increasing proportion of the total pack is being sold under private label, packers at times must meet buyer specifications and compete on a bid-price basis.

The industry shows an intense competition among national brands, a competition centering on product quality and industry services. Such competition includes credit or cash discounts, merchandising services and promotional allowances. These forms of competition tend to be standardized, and do much to offset the competition engendered by prices in any given year.

Strong national trade associations in both the canning and freezing industries serve both large and small packers and provide market information and services to their members.

In summary, the fruit and vegetable canning and freezing industries operate within a stable but competitive industry climate. Prices are determined by pack, stocks and national economic conditions rather than by oligopolistic price management at one extreme or by cut-throat competition at the other.

Some specific products have demonstrated greater historical variations and/or fluctuations in prices and margins at all levels--grower, wholesale and retail. As a general rule, however, packs, stocks, and national economic conditions heavily influence the determination of fruit and vegetable canned and frozen prices.

Historical grower, process, wholesale and retail prices and margins were presented in Table IV-11.

B. Expected Price Changes

If the industry is successful in passing all pollution abatement costs forward to the consumer, the expected increase in price would amount to approximately 1 to 2 percent (assuming earlier abatement strategy levels).1/ This would result in little impact on consumption patterns. In the study by Brandow of Pennsylvania State University previously cited, the price elasticity for all fruits is identified as -.60 and for all vegetables at -.30. This means that a 1 percent increase in price will will result in .6 percent and .3 percent decreases in consumption, respectively. Total per capita consumption of processed fruits is approximately 67 pounds and is expected to climb to 70-75 pounds in 1980;

1/ Agri Division, Dunlap & Assoc., "Economic Impact of Environmental Controls on the Fruit and Vegetable Canning and Freezing Industry." A report for the Council on Environmental Quality, November, 1971.

and total per capita consumption of processed vegetables is now 115 pounds with an expected growth to 120-130 pounds by 1980. Thus, if all costs were passed forward, a resultant decrease of 0.5 to 1.0 percent of approximately 1 to 2 pounds per capita could be expected. This would be less than the total annual increase in consumption resulting from population expansion and projected increases in per capita consumption.

1. Projected Plant Utilization

On the basis of the earlier study cited above, plant shutdowns were projected to occur heavily within the small and medium size categories. This would be largely for firms which have not as yet installed pollution abatement equipment and do not have access to low cost facilities.

Because of rather wide-spread underutilization of total capacity in the industry, marginal firms generally will not attempt to expand their existing facilities to achieve desired economies of scale. The competitive structure of the industry will influence outward migration of firms; thus, the rate of firm closures that has been occurring over the past three decades will increase.

2. Projected Price Response

The ability to pass forward all price increases depends upon many factors including demand, margin, and substitute products. In the fruit and vegetable processing industry, we have seen a historical trend toward a decrease in farm and processor margins for many of the canned fruits and vegetables; however, for frozen citrus juices and other products which are increasing in per capita consumption, the farm margin as a percent of retail costs have decreased while processor margins have increased. There will be, then, differential responses by commodity.

Processors may have more difficulty passing forward increased processing cost for products with stable demand than for those with rising demand such as citrus juices.

As a general rule, it is believed that the grower margins are sufficiently small to prevent a backward price movement. The bulk of the price effects are, therefore, expected to result in increased consumer prices with processors absorbing some of the increase for commodities with stable demand trends. There may be some very minor price absorption at the wholesale and retail levels for specific products.

3. Locational Impact

Many of the marginal processing plants likely to be affected adversely by pollution abatement controls are located in areas or regions of the country that are already relatively economically depressed. Processor, grower and associated businesses are generally a major component of local economic development in these areas and, consequently, any appreciable impact on these businesses will also impact the entire local economy via indirect multiplier effects on area incomes, employment, sales, level of trade, etc. Such effects are likely to be far more consequential in aggregate than the direct impacts of pollution abatement on the industry itself.

4. Secondary Impact

Growth - Aggregate demand growth will likely be tempered as a consequence of pollution abatement costs and expected higher retail prices. Population growth is expected to quickly offset any short-run declines in per capita consumption.

Fresh Product Competition - Fresh fruits and vegetables pose little threat as substitutes for processed products. Because of the convenience offered by processed commodities, they have been steadily gaining on fresh product competition. With the relatively small expected rise in price for processed commodities, this trend is not expected to be reversed. This is, of course, on an industry-wide basis.

Imports of Processed Fruits and Vegetables - The impact of increased imports of processed fruits and vegetables resulting from anticipated increased costs of domestic processed products is generally expected to be limited. With the exception of substantial imports of processed mushrooms and tomato products, imports of vegetables are negligible and would not be expected to increase materially. Apple juice, frozen strawberries, pineapple products and frozen blueberries are the principal fruit products imported . Production areas for pineapple and blueberries are limited in the United States and import of tomato products from Italy and Spain is, in part, associated with style of pack. Frozen strawberries from Mexico are a major competitive item, and increased costs could reduce the competitive position of U. S. frozen strawberries.

However, both U. S. producers of raw products and U. S. processors are large and highly mechanized as compared to foreign suppliers, and in spite of increased costs of pollution abatement, it is probably that the overall increase of imports would be minor.

V. ECONOMIC IMPACT ANALYSIS METHODOLOGY

The following economic impact analysis utilizes the basic industry information developed in Chapters I-IV plus the pollution abatement technology and costs provided by Environmental Protection Agency. The impacts examined include:

Price effects
Financial effects
Production effects
Employment effects
Community effects
Other effects

Because of the influential consequences of financial and production effects on the other impacts, this chapter will emphasize the financial and plant closure analysis.

In general, the approach taken in the impact analysis is the same as that normally done for any feasibility capital budgeting study of new investments. In the simplest of terms, it is the problem of deciding whether a commitment of time or money to a project is worthwhile in terms of the expected benefits derived. This decision process is complicated by the fact that benefits will accrue over a period of time and that in practice the analyst cannot calculate imponderables nor reflect all of the required information which, by definition, must deal with projections of the future, in the cost and benefit analysis. In the face of imperfect and incomplete information and time constraints, the industry segments were reduced to money relationships insofar as possible, and the key non-quantifiable factors were incorporated into the analytical thought process to modify the quantified data. The latter process is particularly important in view of the use of model plants in the financial analysis. In practice, actual plants will differ from the model, and these variances will be considered in interpreting financial results based on model plants.

A. Fundamental Methodology

Much of the underlying analysis regarding prices, financial and production effects is common to each kind of impact. Consequently, this case methodology is described here as a unit with the specific impact interpretations being discussed under the appropriate heading following this section.

The core analysis for this inquiry was based upon synthesizing physical and financial characteristics of the various industry segments through model or representative plants. The estimated cash flows for these model plants are summarized in Chapter III. The primary factors involved in assessing the financial and production impact of pollution control are profitability changes, functions of the cost of pollution control and the ability to pass along these costs in higher prices. Admittedly, in reality, closure decisions are seldom made on a set of well-defined, common economic rules; they also include a wide range of personal values, external forces such as the ability to obtain financing, and the recognition that the production unit is an integrated part of a larger and influential cost cener.

Such circumstances include but are not limited to the following:

1. The owner-operator lacks knowledge about the actual financial condition of the operation because of inadequate accounting procedures. This is especially likely to occur among small, independent operators who do not have effective cost accounting systems.

2. The owner does not wish to replace obsolete, fully depreciated equipment and plant. He can continue in production as long as he can cover labor and materials costs and/or until the equipment deteriorates to an irreparable and inoperative condition.

3. Opportunities for changes in the ownership structure of the plants (or firms) exist through acquisition by conglomerates, large diversified firms, or through other acquisition circumstances which would permit re-evaluation of assets or in situations where new ownership may be willing to accept temporary low returns with the expectation that operations can become profitable.

4. Personal values and goals associated with business ownership override or ameliorate rational economic rules (e.g., psychic income).

5. The production unit, if part of a larger economic entity, may (1) use raw materials produced in another plant within the firm that must have an assured market or (2) supply raw materials to another unit within the firm. When the profitability of the second operation may continue indefinitely because the total enterprise is profitable.

6. The owner-operator expects adverse conditions and consequent losses. His ability to absorb short-term losses depends upon his access to funds through credit or personal resources not presently utilized.

7. There are very low (approaching zero) opportunity costs for the fixed assets and for the owner-operator's managerial skills and/or labor. As long as the operator can meet labor and materials costs, he will continue to operate. Hy may even operate with gross revenues below variable costs until he has exhausted his working capital and credit.

8. The value of the land on which the plant is located is appreciating at a rate sufficient to offset short-term losses, funds are available to meet operating needs, and opportunity costs of the owner-operator's managerial skills are low.

The above factors are generally associated with proprietorships and closely held enterprises rather than publicly held corporations.

While the above factors are present in and relevant to business decisions, common economic rules are sufficiently universal to provide a useful and reliable insight into potential business responses to new investment decisions as represented by required investment in pollution control facilities. Thus, economic analysis was used as the core analytical procedure. Given the pricing conditions, the impact on profitability (and possible closure) was determined by computing the ROI under conditions of the new price and incremental investment in pollution control. The primary consequence of profitability changes was the impact on the plant regarding plant shutdown rather than making the required investment in meeting pollution control requirements.

In the most fundamental case, a plant will be closed when variable expenses (Vc) are greater than revenues (R) since by closing the plant, losses can be avoided. Plants may continue to operate, however, where apparently $Vc > R$. The reasons for this include:

- a lack of cost acounting detail to determine when $Vc > R$.

- the opportunity cost of labor or other resource is less than market values. (This would be particularly prevalent in proprietorships where the owner considers his labor as fixed.)

- other personal and external financial factors exist.
- revenues are expected to shortly increase to cover variable expenses.

A more probable situation is the case where $Vc < R$ but revenues are less than variable costs plus cash overhead expenses (TCc) which are fixed in the short run. In this situation a plant would likely continue to operate as contributions are being made toward covering a portion of these fixed cash overhead expenses. The firm cannot operate indefinitely under this condition, but the length of this period is uncertain. Basic to this strategy of continuing operations is the firm's expectation that revenues will increase to cover cash outlay. Factors involved in closure decisions include:

- extent of capital resources (if the owner has other business interests or debt sources that will supply capital input, the plant will continue),
- there are not adequate cost accounting details or procedures to know that TCc R (particularly in multiplant or business situation), or
- labor or other resources are considered fixed and the opportunity cost for these items is less than market value.

The identification of plants where $TCc > R$, but $Vc < R$ leads to an estimate of plants that should eventually be closed if revenues do not increase. However, the timing of such closures is difficult to predict.

The next level of analysis, where $TCc < R$, involves estimating the earnings before and after investment in pollution abatement. So long as $TCc < R$ it seems likely that investment in pollution control will be made and plant operations continued so long as the capitalized value of earnings (CV) (at the firm's cost of capital is greater than the scrap or salvage value (S) of the sunk plant investment. If $S > CV$, the firm could realize S in cash and reinvest and be financially better off. This presumes reinvesting at least at the firm's (industry) cost of capital.

Computation of CV involves discounting the future earnings flow to present worth through the general discounting function:

$$V = \sum_{n=1}^{t} A_n (1+i)^{-n}$$

where

V = present value
A_n = a future value in nth year
i = discount rate as target ROI rate
n = number of conversion products, i.e., 1 year, 2 years, etc.

It should be noted that a more common measure of rate of return is the book rate, the rate which measures the after-tax profits as a ratio of invested capital. These ratios should not be viewed as a different estimate of profitability as opposed to DCF measures (discounted cash flow); they reflect an entirely different profitability concept. The reader is cautioned not to compare the DCF rates directly with book rates. Although both measures are reported in the analyses, the book rate is reported for informational purposes only.

The two primary types of DCF measures of profitability were used. The first is the internal rate of return or yield, and it is the computed discount rate (yield) which produces a zero present value of the cash flow. The yield is the highest rate of interest the investor could pay if all funds were borrowed and the loan were returned from cash proceeds of the investment. The second DCF measure is the net present value concept. Rather than solve for the yield, a discount rate equivalent to the firm's cost of capital was used. Independent investments with net present values of above zero were accepted; those below zero wer rejected. The concept of comparing capitalized earning with the sunk investment value is a variation of the net present value method.

The data input requirements for book and DCF measures were derived, to a large extent, from the same basic information although the final inputs were handled differently for each.

1. Benefits

In this analysis, benefits for the book analysis were called after-tax income and for the DCF analysis, after-tax cash proceeds. The computation of each is shown below:

$$\text{After tax income} = (1 - T) \times (R - E - I - D)$$

$$\text{After tax cash proceeds} = (1 - T) \times (R - E - D) + D$$

where

T = tax rate

R = revenues

E = expenses other than depreciation and interest

I = = interest expense

D = depreciation charges

Interest in the cash proceeds computation was omitted since it is reflected in the discount rate, the after-tax cost of capital (see below). Depreciation was included in the DCF measure only in terms of its tax effect and was then added back so that a cash flow over time was obtained.

A tax rate of 48 percent was used throughout the analysis. Accelerated depreciation methods, investment credits, carry forward and carry back provisions were not used due to their complexity and special limitations. It was recognized that in some instances the effective tax rate may be lower in a single plant situation, but the firm's tax rate will be close to the 48 percent rate.

The revenue, expenses, interest and depreciation charges used were those discussed in Chapter III and Chapter VI for pollution control facilities. These items were assumed to be constant over the period of analysis.

2. Investment

Investment is normally thought of as outlays for fixed assets and working capital. However, in evaluating closure of an on-going plant where the basic investment is sunk, the value of that investment must be made in terms of its liquidation or salvage value, that is its opportunity cost or shadow price.[1] For purposes of this analysis, sunk investment was taken as the sum of equipment salvage value plus land at current market value plus the value of the net working capital (current assets less current liabilities) tied up by the plant (see Chapter III for values). This same amount was taken as a negative investment in the terminal year. Replacement investment for plant maintenance was taken as equal to annual depreciation, which corresponds to operating policies of some managements and serves as a good proxy for replacement in an on going business.

Investment in pollution control facilities was taken as the estimates provided by EPA and shown in Chapter VI. To reflect in-place facilities, only incremental values were used. Only the value of the involved land was taken as a negative investment in the terminal year.

The above discussion refers primarily to the DCF analysis. Investment used in estimating book rates was taken as invested capital - book value of assets plus net working capital. In the case of new investment, its book rate was estimated as 50 percent of the original value.

3. Cost of Capital - After Tax

Return on invested capital is a fundamental notion in U. S. business. It provides both a measure of the actual performance of a firm as well as its expected performance. In this latter case, it is also called the cost of capital. The cost of capital is defined as the weighted average of the cost of each type of capital employed by the firm, in general terms equities and interest bearing liabilities. There is no methodology that yields the precise cost of capital, but it can be approximated within reasonable bounds.

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[1] This should not be confused with a simple buy-sell situation which merely involves a transfer of ownership from one firm to another. In this instance, the opportunity cost (shadow price) of the investment may take on a different value.

The cost of capital was determined for purposes of this study by examining Troy's Financial Almanac and industry provided data. The weights of the two respective types capital were estimated at 60 percent debt and 40 percent equity. The cost of debt was assumed to be 8 percent. The cost of equity was determined from the ratio of before tax income to net worth and estimated at 16.5 percent.

To determine the weighted average cost of capital, it is necessary to adjust the before tax costs to after tax costs. This was done by multiplying the costs by one minus the tax rate (assumed to be 48 percent, the marginal federal income tax rate).

Weighted Average Cost of Capital

Item	Weight	Before tax cost	Tax Rate	After tax cost	Weighted cost	
Debt	.60	.08	.48	.0416	.02496	
Equity	.40	.165	.48	.0858	.03432	
					.05928	.06

As shown in the above computation, the estimated after tax cost of capital is 7.0 percent. (The before tax costs were compiled from several sources and are assumed to be representative of the industry.)

4. Construction of the Cash Flow

A twenty-two period cash flow was used in this analysis and was constructed as follows:

1. Sunk investment (salvage market value of fixed assets plus net working capital) taken in year t_0.
2. After tax cash proceeds taken for years t_1 to t_{20}.
3. Annual replacement investment, equal to annual current depreciation taken for years t_1 to t_{20}.
4. Terminal value equal to sunk investment taken in year t_{21}.

5. Incremental pollution control investment taken in year t_o for 1977 standards and year t_6 for 1983 standards.

6. Incremental pollution expenses taken for years t_1 to t_{20} for 1977 standards and years t_7 to t_{20} for 1983 standards.

7. No replacement investment taken on baseline pollution investment on assumption of 20-year useful life.

8. Terminal value of pollution facilities are assumed equal to zero in year t_{21}.

B. Price Effects

At the outset, it must be recognized that price effects and production effects are mutually interative. In fact, the very basis of price analysis is the premise that prices and supplies (production) are functionally related variables which are simultaneously resolved.

The solution of this requires knowledge of demand growth, price elasticities, supply elasticities, the degree to which regional markets exist, the degree of dominance experienced by large firms in the industry, market concentration exhibited by both the industry's suppliers of inputs and purchasers of outputs, organization and coordination within the industry, relationship of domestic output to the world market, existence and nature of complementary goods, cyclical trends in the industry, current utilization of capacity, and exogenous influences upon price determination (e.g., governmental regulation).

In view of the complexity and diversity of factors involved in determining market price, a purely quantitative approach to the problem of price effects was not feasible; hence, the simultaneous considerations suggested above will be made. The judgment factor will be heavily employed in determining the supply response to a price change and alternative price changes to be employed.

As a guide to the analysis of price effects, the estimated price required to leave the model plant segment as well off was computed. The required price increase at the firm level was evaluated in light of the relationship of the model plant to the industry and the competitive position of the industry. The required price increase was readily computed using the DCF analysis described above, but dealing only with the incremental pollution investment and cash proceeds.

Application of the above DCF procedure to these costs yielded the present value of pollution control costs (i.e., investment plus operating cost less tax savings). The price increase required to pay for pollution control was calculated by the formula

$$X = \frac{(PVP)\,(100)}{(1-T)\,(PVR)}$$

where:

X = required percentage increase in price

PVP = present value of pollution control costs

PVR = present value of gross revenue starting in the year pollution control is imposed

Note that this formula assumed that incremental profits resulting from the price increase were taxed at a rate of 48 percent.

C. Financial Effects

In Chapter II, the financial characteristics of model plants were presented. These data served as the base point for the analysis of the financial effects of pollution control. The primary focus of analysis was upon profitability in the industry and the ability of the firms to secure external capital. Obviously, this portion of the analysis could not be divorced from production effects since profit levels and the ability to finance pollution abatement facilities have a direct influence on supply responses--utilization of capacity and plant closures.

To measure profitability, the analysis employed after-tax book rate of return on invested capital and cash flow (after-tax profit plus depreciation) measurements. After-tax profit as a percent of sales was also reported in order to compare financial data with standard industrial measures.

D. Production Effects

Potential production effects include the reductions of capacity utilization rates, plant closures, and industry stagnation. Reductions in capacity utilization were estimated via qualitative techniques given the analysts' knowledge of the industry. The same was true for assessing the extent to which plant closures may be offset by increases in capacity utilization on the part of plants remaining in operation. Data limitations and time constraints required that the impact of pollution control standards upon future industry growth also be estimated via qualitative methods.

The remaining effect, plant closures, is very difficult to measure realistically as discussed above in Section A. As a starting point in the plant closure analysis, a shutdown model was employed to indicate which model plants should be closed, which would be marginal operations and which, sound operations. These conclusions assumed that a plant would close when its net present value of the cash flow is less than zero.

The above analysis was done under a without-pollution control condition and a with-pollution control condition. The former (and including historical trends) established a baseline against which total closures after pollution control were compared to arrive at an estimate of closures due to pollution control.

E. Employment Effects

The production effects of estimated production curtailments, plant closings, and changes in industry growth are major factors affecting industry employment. The employment effects stemming from each of these production impacts were estimated. To the extent possible, the major employee classifications involved were examined as was the potential for re-employment.

F. Community Effects

Although the direct impacts of job losses upon a community are immediately apparent, in many cases, plant closures and cutbacks have a far greater impact than just that of employment loss. Multiplier effects may result in even more unemployment. Badly needed taxes for vital community services may dwindle. Community pride and spirit may be dampened. However, in some cases, the negative community aspects of production effects may be short-term and relatively minor within the overall community. In a few cases, the closure of a plant may actually be viewed as a positive net community effect (e.g., a small plant with a high effluent load in an area with a labor shortage).

These impact factors were qualitatively analyzed as appropriate.

G. Other Effects

Other impacts such as direct balance of payments effects were also included in the analysis. This, too, involved qualitative analyses.

VI. POLLUTION CONTROL REQUIREMENTS AND COSTS

Water pollution control requirements and costs used in this analysis were furnished by the Effluent Guidelines Division of the Environmental Protection Agency from materials developed by the Ben Holt Company.[1] These basic data covered selected types of apple, citrus and potato processing plants in the fruit and vegetable processing industry, and this information was adapted to the types and sizes of processing plants specified in this analysis.[2]

Three effluent control levels were considered in the information provided:

BPT	-	Best Practicable Control Technology Currently Available, to be achieved by July 1, 1977
BAT	-	Best Available Pollution Control Technology Economically Achievable, to be achieved by July 1, 1983
NSPS	-	New Source Performance Standards, apply to any source for which construction starts after the publication of the proposed regulations for the Standards

No pretreatment controls were assumed necessary for the model plants.

A. Categories of Canned and Preserved Fruits and Vegetable Plants

The data for the standards of performance and the costs for achieving them were provided by EPA. Data were provided for large and small plants categorized as follows:

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[1] Development Document for Effluent Limitations Guidelines and Standards of Performance--Canned and Preserved Fruits and Vegetables Industry, The Ben Holt Company, 1973.

[2] Pollution control guidelines and treatment costs were not provided for spinach and asparagus products; hence, no further analysis is presented.

Citrus Products
Apple Juice
Apple Products, except Juice
Frozen Potatoes
Dehydrated Potato Products

These data, however, were not compatible with the model plant data developed in Phase I of this report and were modified accordingly. The model plant structure used in this report consisted of the following plants in small, medium, and large size categories: [1]

Frozen Orange Juice Concentrate
Single Strength Orange Juice
Apple Juice
Apple Slices
Apple Sauce

(An extensive search was made to obtain information regarding the potato processing industry, but because information regarding revenue, production cost, profits and investment is closely held, we were unable to develop sufficient economic information regarding frozen and dehydrated potato plants to include them in this analysis (Chapter III).[2])

The above categories of plants were evaluated separately from the standpoint of establishing effluent limitation guidelines which are described in the following section.

B. Effluent Limitation Guidelines

Specific effluent limitation guidelines were provided by EPA for this study, as recommended by Ben Holt, Inc. Two levels of control were recommended: (1) BPT--Best Practicable Control Currently Available (1977), and (2) BAT--Best Available Technology Economically Achievable (1983). The NSPS--New Source Performance Standards--were set to equal the BAT guidelines. Because they are not considered necessary, pretreatment standards were provided for the industry segments studied.

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[1] Single-product model plants were developed on the basis of available secondary data. Multi-product plants are common, but numerous product combinations and volume-mixes exist. Single-product plants were assumed to best reflect the general magnitude of impact involved.

[2] Potato processing model plant data were unobtainable within the scope of study. A preliminary impact assessment for potatoes is contained In Appendix A.

For reference, the recommended BPT and BAT guidelines to be met by the industy segments involved in this study are as shown in Table VI-1 and VI-2. The types of treatment which are proposed to achieve the effluent limitations indicated are described briefly in the following section. Alternative treatment strategies are available to achieve both the BPT and BAT guidelines.

C. Pollution Control Requirements

To achieve the effluent limitations as proposed above, the fruit and vegetable processing industry is likely to apply a variety of treatment strategies. A number of alternatives were presented to EPA (Ben Holt Co.); these are briefly described in Table VI-3. Alternatives B and E will meet BPT guidelines, and Alternatives C, F and G, the BAT guidelines. Alternative D (spray irrigation) will meet both the BPT and BAT guidelines (if it can be applied). It is further noted that B to C and E to F or G are logical combinations to first meet BPT and then the BAT guidelines.

Not all plants will be able to use the least costly system (estimated costs are shown below) based primarily on land availability--either for lagoons or spray irrigation. Table VI-9 below estimates selected combinations of treatment strategies which may be used.

D. Pollution Control Costs

Pollution control cost estimates were provided by EPA (from Supplement A of the Development Document prepared by the Ben Holt Co.) for selected large and small plants in each of the principal categories defined above, i.e., apple juice, apple products except juice, and citrus products. Pollution control investment and operating cost data were included for alternative treatment practices within each category, i.e., alternatives B, C, D, E, F and G, which correspond to the BPT and BAT effluent reduction guidelines as has been indicated.

Additionally, DPRA generated additional investment and operating cost data for the different sizes of plants within each category. A summary of these estimated costs is shown in Table VI-4.

Table VI-1. Recommended BPT (Best Practicable Control Technology) effluent limitation guidelines for selected fruit and vegetable processing plants [1]. (Maximum monthly averages.)

Plant Subcategory	BOD5 (kg/kkg)	Suspended Solids (kg/kkg)
Apples: Slices and sauce (Both small & large plants)	.55	.70
Apples: Juice (Both small & large plants)	.30	.40
Citrus: Juice, Oil, Segments		
Plant capacity less than 370 kkg/D	.40	.85
Plant capacity greater than 370 kkg/D		
Citrus: Peel products (Both small & large plants)		
Citrus: Juice, Oil, Segments, Peel Products (Both small & large plants)		
Potatoes: Dehydrated products (Both small & large plants)	1.20	1.40
Potatoes: Frozen products		
Plant capacity less than 320 kkg/D	1.40	1.40
Plant capacity greater than 320 kkg/D		

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[1] Source: Development Document, p. 144.

Table VI-2. Recommended BAT (Best Available Technology Economically Achievable) effluent limitation guidelines for selected fruit and vegetable processing plants.[1]

PLANT SUBCATEGORY	BOD5 (kg/kkg)	SUSPENDED SOLIDS (kg/kkg)
APPLES: Slices and Sauce	.10	.10
APPLES: Juice	.10	.10
CITRUS: Juice, Oil, Segments	.07	.10
CITRUS: Peel Products		
CITRUS: Juice, Oil, Segments and Peel Products		
POTATOES: Dehydrated Products	.17	.55
POTATOES: Frozen Products	.17	.55

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[1] Source: Development Document, 1973.

Table VI-3 . Summary of treatment components for alternative strategies of effluent reduction: Apple Juice Only, Apple Products except Juice, and Citrus Products [1/]

Treatment Component	Alternative Strategies for Apple Juice Only						Alternative Strategies for Apple Products except Juice						Alternative Strategies for Citrus Products					
	B	C	D	E	F	G	B	C	D	E	F	G	B	C	D	E	F	G
Screening (Level A)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Primary Sedimentation																		
Cooling Tower													X			X	X	X
Shallow Lagoon (30 day)			X					X	X					X	X			
Aerated Lagoon--Settling		X						X					X	X				
Aerated Lagoon--No Settling	X	X				X	X	X				X	X	X				X
Anaerobic/Aerobic Lagoon														X				
Activated Sludge				X	X	X				X	X	X				X	X	X
Sand Filtration					X	X					X	X					X	X
Spray Irrigation			X						X						X			

[1/] Source: EPA and the Ben Holt Co., Inc. Levels B and E are alternative BPT control strategies, levels C, F and G are alternative BAT control strategies, level D provides both BPT and BAT effluent reductions.

Table VI-4. Estimated Investment (I) and Annual Costs (AC) for Best Practicable Control Technology (BPT) and Best Available Control Technology (BAT) for wastewater effluent treatment for selected plants in the fruit and vegetable processing industry ($1,000)

			Alternative Effluent Reduction Strategies									
			B (BPT)		C (BAT)		D (BOTH) 1/		E (BPT)		F (BAT)	
Type of Plant	Category	Tons/day	I	AC	I	AC	I	AC	I	AC	I	AC
Citrus												
Frozen Conc. Or. Ju.	S	144	201	42	423	87	208	48	620	37	709	50
Frozen Conc. Or. Ju.	M	528	276	53	578	110	363	84	862	53	984	69
Frozen Conc. Or. Ju.	L	1,072	382	68	797	114	583	136	1,205	75	1,374	96
Single Strength Or. Ju.	S	54	184	40	387	82	172	39	563	33	644	46
Single Strength Or. Ju.	M	109	195	41	409	85	194	44	597	36	684	48
Single Strength Or. Ju.	L	272	226	46	475	95	260	60	700	42	800	57
Apples												
Canned Slices	S	32	24	17	58	41	37	8	215	8	249	15
Canned Slices	M	64	28	25	66	42	43	10	228	9	263	16
Canned Slices	L	69	32	33	74	43	49	12	241	10	277	17
Canned Sauce	S	32	24	17	58	41	37	8	215	8	249	15
Canned Sauce	M	64	28	25	66	42	43	10	228	9	263	16
Canned Sauce	L	96	32	33	74	43	49	12	241	10	277	17
Canned Juice	S	48	9	3	16	8	17	3	136	4	155	10
Canned Juice	M	96	13	4	22	10	25	5	151	5	174	11
Canned Juice	L	144	17	5	29	12	33	7	166	6	193	12

1/ Alternative D, Spray Irrigation, is estimated to meet both the BPT and BAT guidelines.

The method used to develop the cost data in Table VI-4 involved linear interpolation and extrapolation of EPA's investment and annual operating cost data. That is, EPA's data were for small and large plants of specified sizes (in tons perday) and DPRA model plants (small, medium and large) were of different sizes, ranging from smaller to larger than those for which data were estimated. Insufficient information was available to establish non-linear relationships of investment and annual operating costs by size; therefore, linear ;functions were assumed to approximate the costs for this study.

For reference, the linear functional relationships used to generate the pollution control investment and annual costs used in the impact analysis are as shown in Tables VI-5 to VI-7. The equations were derived given the two data points (small plant and large plant, as shown) provided both for investment and annual costs.

E. Status of Wastewater Treatment

Approximately two-thirds of the plants in the citrus and apple processing industries utilize municipal systems or land irrigation waste disposal systems (Table VI-8). For those plants further treatment requirements are not required to meet the limitation guidelines of this study.

The remaining one-third of these industries have none or only partial treatment facilities. Some currently meet the BPT guidelines but no specific estimate is known. However, nearly all (99 percent) of these plants require further treatment facilities to meet the BAT (1983 guidelines.

Table VI-8 shows a more detailed summary of the status of wastewater treatment in the citrus, apple and potato processing industries. These data are sample data only, but they are assumed to reflect the status of the industry categories shown. Further information was unavailable regarding the status of all plants in the industry.

Because alternative treatment strategies are available, a further estimate is needed of which treatment strategies will be employed to meet the BPT and BAT guidelines (including potential hook-up with municipal systems). Table VI-9, based on EPA data, indicates this study's assumptions.

Table VI-5. Summary of investment (I) and annual cost (AC) data for selected citrus products plants. And estimated linear cost relationships for alternative treatment practices

Treatment Practice and Type Cost		Plant Data [1/] 400 TPD(S) ($000)	Plant Data [1/] 4,000 TPD(L) ($000)	Linear Cost Fcn:[2/] Y=a+bX 'a'	Linear Cost Fcn:[2/] Y=a+bX 'b'
Treatment B:	I	251.2	950.2	173.5	.1942
	AC	49.7	151.2	38.4	.0282
Treatment C:	I	526.2	1,977.4	365.0	.4031
	AC	102.5	321.3	78.2	.0608
Treatment D:	I	311.5	1,767.5	149.7	.4044
	AC	72.1	419.9	33.8	.0958
Treatment E:	I	781.2	3,054.2	528.6	.6314
	AC	47.5	194.7	31.1	.0409
Treatment F:	I	892.3	3,473.4	605.5	.7170
	AC	62.8	241.4	43.0	.0496
Treatment G:	I	973.3	3,825.4	656.4	.7923
	AC	81.2	296.1	57.3	.0597

[1/] Data provided by EPA. Supplement Table 32: Investment and annual costs by effluent reduction level for citrus products subcategory for typical small plant (400 TPD) and large plant (4,000 TPD).

[2/] Indicates functional form where Y is either I or AC and X is tons per day (TPD) processed.

Source: Development Document, p. 144.

Table VI-6. Summary of investment (I) and annual cost (AC) data for selected apple products except juice plants. And estimated linear cost relationships for alternative treatment practices

Treatment Practice and Type Cost		Plant Data [1/]		Linear Cost Fcn: Y=a+bX [2/]	
		100 TPD(S) ($000)	1,000 TPD(L) ($000)	'a'	'b'
Treatment B:	I	32.0	135.2	20.5	.1147
	AC	11.8	34.4	9.3	.2511
Treatment C:	I	74.0	278.2	51.3	.2269
	AC	42.2	60.7	40.1	.0206
Treatment D:	I	49.0	199.2	32.3	.1669
	AC	11.0	45.3	7.2	.0381
Treatment E:	I	242.0	600.2	202.2	.3980
	AC	9.5	33.3	6.9	.0264
Treatment F:	I	280.0	692.7	234.1	.4586
	AC	17.4	48.8	14.1	.0327
Treatment G:	I	295.0	757.7	243.6	.5141
	AC	22.8	79.2	16.5	.0627

[1/] Data provided by EPA. Supplement Table 31: Investment and annual costs by effluent reduction level for apple products except juice (only) subcategory for typical small plant (100 TPD) and large plant (1,000 TPD).

[2/] Indicates functional form where Y is either I or AC and X is tons per day (TPD) processed.

Source: Development Document, p. 143.

Table VI-7. Summary of investment (I) and annual cost (AC) data for selected apple juice (only) plants. And estimated linear cost relationships for alternative treatment practices

Treatment Practice and Type Cost		Plant Data [1/]		Linear Cost Fcn [2/] Y=a+bX	
		100 TPD(S) ($000)	500 TPD(L) ($000)	'a'	'b'
Treatment B:	I	13.0	46.2	4.7	.0830
	AC	4.3	14.0	1.9	.0243
Treatment C:	I	23.0	80.2	8.7	.1430
	AC	10.0	25.2	6.2	.0380
Treatment D:	I	26.0	92.4	9.4	.1660
	AC	5.1	22.1	0.85	.0425
Treatment E:	I	152.0	272.2	122.0	.3005
	AC	5.3	11.8	3.7	.0163
Treatment F:	I	176.0	334.7	136.3	.3968
	AC	11.1	22.1	8.4	.0274
Treatment G:	I	182.0	356.7	138.3	.4368
	AC	13.1	28.6	9.2	.0389

[1/] Data provided by EPA. Supplement Table 30: Investment and annual costs by effluent reduction level for apple juice (sale product) subcategory for typical small plant (100 TPD) and large plant (500 TPD).

[2/] Indicates functional form where Y is either I or AC and X is tons per day (TPD) processed.

Source: Development Document, p. 142.

Table VI-8. Summary of industry wastewater treatment status based on sample data from the Ben Holt Co. (BH) and the National Canners Association (NCA)

Type of Product		Number of Plants	Percent of Plants by Type of Treatment			
			Municipal	Land (Irrig.)	Biological	None
Citrus	BH	59	25	47	21	7
	NCA	6	30	42	5	23
	Total[1]	65	26	46	20	8
Apple Products	BH	41	33	38	14	15
	NCA	13	23	31	15	31
	Total	54	30	36	15	19
Potatoes	BH	41	10	44	36	10
	NCA	10	20	60	10	10
	Total	51	12	47	31	10
Total	BH	149	23	43	24	10
	NCA	29	24	43	11	22
	Total	170	23	43	22	12

[1] Percentage totals are weighted averages based on number of plants in the BH and NCA samples. Note samples are not necessarily mutually exclusive. NCA data summarized from information provided to DPRA.

Table VI-9. Estimated schedule of treatment strategies to be used by citrus and apple processors to meet the BPT and BAT effluent limitations guidelines [1]

Description	BPT Treatment		BAT Treatment	
	Strategy	Percent	Strategy	Percent
Citrus				
Municipal	--	12	--	12
Secondary	B	16	C	16
	E	16	F	10
			G	6
Land	D	56	D	56
		100		100
Apple Products				
Municipal	--	26	--	26
Secondary	B	10	C	10
	E	10	F	6
			G	4
Land	D	54	D	54
		100		100

[1] Schedule applies only to those plants which are not already on municipal systems or using land (irrigation) disposal methods.

Source: Derived from schedules provided by EPA.

Given the estimated current treatment status of citrus and apple products processing plants as summarized in Table VI-8, and given the estimated schedules of treatment strategies for plants which are not presently on municipal or land disposal systems as indicated in Table VI-9, then it is possible to project distributions of treatment practices for 1977 and 1983 as shown in Table VI-10. That is, the estimated distributions of treatment alternatives to meet the BPT (1977) and BAT (1983) proposed standards are as indicated.

F. Relationships of Model Plants to Industry Categories

The citrus model plants in this analysis process only orange juice products: frozen concentrated orange juice and canned single strength orange juice. Though many other citrus products are packed, this study emphasizes orange juice products because orange juice concentrate dominates the frozen pack and single strength orange juice is a major canned citrus product.

Recently, 1970-72, frozen concentrated orange juice accounted for over 90 percent of the frozen citrus pack as indicated in Table VI-11 (lemon juice and lemonade pack data are not reported); canned single strength orange juice comprised about 39 percent of the canned citrus juice products.

Because of the dominance of frozen concentrated orange juice, the model plants used are assumed to effectively reflect this segment of the industry. Although canned single strength orange juice plants represent a much smaller portion of the canned citrus products segment, data reported by A. H. Spurlock (Costs of Processing, Warehousing and Selling Florida Citrus Products, 1971-72 Season, Econ. Report 46, Univ. of Florida, April, 1973) show that the average costs per case for processing orange juice, grapefruit juice and blended juice are quite similar and the processing characteristics, comparable. The canned single strength orange juice model plants are, therefore, representative of citrus product canning operations.

Canned grapefruit sections, canned citrus salad, and chilled citrus juices and salad are not represented by the model plants, but these products are relatively minor compared with the main processed products as described. Plant data regarding these products is also meager.

Table VI-10. Estimated status of wastewater treatment in the citrus and apple processing industries plus projected distribution of treatment practices

Type of Product and Time Period	Type of Treatment				
	Municipal (%)	Land Disposal [2] (%)	Biological (%)	None (%)	Total (%)
Citrus					
1973 (Current) [1]	26	46	20	8	100
1977 (BPT)	29	62	B:4 E:5	--	100
1983 (BAT)	29	62	C:4 F:3 G:2	--	100
Apples					
1973	30	36	15	19	100
1977	39	54	B:4 E:3	--	100
1983	39	54	C:4 F:2 G:1	--	100

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[1] Current status based on sample data presented in Table VI-8. Projection (rounded) based on estimated schedule presented in Table VI-9. Schedule applied to Biological and None categories only.

[2] Land disposal refers to spray irrigation strategy D as described.

Table VI-11. Selected pack statistics for processed citrus products, 1970-72

Type of Pack	Annual Pack 1970	Annual Pack 1971	Annual Pack 1972	Average Percent 1/
	------ Thousands of Gallons ------			
Frozen Concentrated Citrus Juices				
Orange	126,402	125,187	134,229	93.3%
Grapefruit	4,294	6,870	8,798	4.8%
Grapefruit-Orange	16	18	22	.1%
Lemon	N.A.	N.A.	N.A.	N.A.
Lemonade	N.A.	N.A.	N.A.	N.A.
Limeade	1,345	1,648	1,498	1.1%
Tangerine	785	1,090	1,220	.8%
				100.0%
Canned Citrus Juices -- Thousands of Actual Cases				
Grapefruit	23,854	24,891	N.A.	57.1
Orange	16,966	15,927	N.A.	38.6
Blended Citrus	2,046	1,626	N.A.	4.3
Tangerine	N.A.	N.A.	N.A.	N.A.
				100%
Other Citrus Products				
Grapefruit Sections	3,841	3,113	N.A.	

1/ Calculated for years shown and for pack data reported only.

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1973, Edward E. Judge & Sons, Inc., Westminister, Md., 1972

Apple canning operations dominate the apple processing industry. As shown in Table VI-12, about 61 percent of the canned apples are packed as apple sauce, about 33 percent of the cases packed are apple juice, and only 6 percent are sliced or whole canned apples. By comparison, frozen apples and sauce represent only about 5 to 6 percent of the total canned volume packed.

The model plants involving canned apple products reflect the major processing operations of concern in this study. An advantage of the single product models is that individual product line effluent characteristics can be assessed. However, a more general problem is the evaluation of multiproduct plants (apples only or apples plus other products) which are inadequately represented by the single product model plants.

The single product canned apple products model plants of this study are taken as a first approximation of the expected impacts on various segments of the apple processing industry. In the case of multiple apple products, some judgment can be made of composite impacts by weighting the individual product line impacts. Consideration of additional products would essentially require a plant by plant analysis within the industry, an approach beyond the scope of this study.

Table VI-12. Selected pack statistics for apple products, 1970-72

Type of Pack	1970	1971	1972	Average Percent 1/
Canned Apple Products -- Thousand of Actual Cases --				
Apples	2,271	2,564	N.A.	5.7%
Apple Sauce	24,291	26,399	N.A.	60.3%
Apple Juice	14,472	14,148	N.A.	34.0%
Frozen Apple Products -- Thousands of Pounds				
Apples and Sauce	100,370	96,999	130,377	
Est. Case Equiv.	(2,478)	(2,395)	(3,219)	

1/ Calculated for pack data as reported.

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1973, Edward E. Judge & Sons, Inc., Westminister, Md., 1972.

VII. IMPACT ANALYSIS [1/]

The effect of imposing direct discharge effluent guidelines on the citrus and apple products processing industries will be moderate on an industry-wide basis; however, selected segments of these industries will be impacted severely. Single strength orange juice plants will be impacted seriously regardless of size; small plants in the apple slices and apple sauce segments of the industry may shut down.

A mitigating circumstance in the processing industries studied is that approximately two-thirds of the plants either are tied into municipal treatment systems or currently have in place land disposal (spray irrigation) systems. The former plants are not directly subject to the guidelines of this study. The latter plants employ a treatment strategy that is generally acceptable to meet both the proposed BPT (Best Practicable Control Technology) and BAT (Best Available Technology Economically Achieveable) guidelines; consequently, only about one-third of the industries studied will be required to upgrade and/or install waste treatment systems.

Because process wastes from the fruits and vegetable processing industries are generally well suited for biological treatment in municipal waste treatment systems, pretreatment effluent limitation guidelines and associated pretreatment control practices were not specified for this study. The new source performance standards (NSPS) were set equal to the BAT guidelines for 1983; therefore, NSPS impacts are considered comparable to those thown for the BAT level of control.

In this chapter, impacts of the BPT and the BAT proposed standards and associated abatement strategies are discussed. Estimated impacts are based primarily on expected financial effects of the pollution control costs (as provided) on representative model plants in the industry.

The impacts considered in this analysis include the following:

- Price effects
- Financial effects
- Production effects
- Employment effects
- Community effects
- Other effects, e.g., balance of payments

[1/] A preliminary impact analysis of water pollution controls on the potato processing industry is reported in Appendix A.

A. Price Effects

Model plants for specific segments of both the citrus and apple products processing industries were simulated and evaluated with and without pollution controls. One analysis estimated the percentage price increase that would be required to recover the estimated cost of pollution control. A total of 15 model plant situations were assessed. A brief summary of the estimated price increases required to recover costs are indicated immediately below. A more detailed summary which also illustrates the treatment strategies involved is shown in Table VII-1.

Plant and Size Class	Percent Change in Price Needed[1/] BPT (%)	Percent Change in Price Needed[1/] BAT (%)
Citrus - Frozen Concentrate O.J.		
Small	1.9 - 2.5	2.1 - 4.1
Medium	.7 - 1.0	1.1 - 1.5
Large	.4 - .7	.8 - .9
Citrus - Single Strength O.J.		
Small	4.4 - 5.5	4.4 - 9.5
Medium	2.3 - 3.0	2.5 - 4.9
Large	1.1 - 1.4	1.3 - 2.2
Apples - Canned Slices		
Small	1.0 - 1.8	1.0 - 4.3
Medium	.6 - 1.3	.6 - 2.3
Large	.5 - 1.1	.5 - 1.5
Apples - Canned Sauce		
Small	.8 - 1.5	.8 - 3.6
Medium	.5 - 1.1	.5 - 1.9
Large	.4 - .9	.4 - 1.3
Apples - Canned Juice		
Small	.6 - 1.7	.6 - 2.8
Medium	.4 - .9	.5 - 1.6
Large	.3 - .7	.5 - 1.2

[1/] Price change such that net income of the plant remains constant. Ranges reflect alternative treatment strategies.

Table VII-1. Percent increase in prices required after pollution controls to maintain net income for selected model plants.

	Size		Treatment Alternative				
			BPT		BAT		Both
Type of Plant	Class	Tons/Day	B	E	C	F	D
Citrus							
Frozen Concentrate, Orange Juice	S	144	1.9	2.5	4.1	3.2	2.1
	M	528	.7	1.0	1.5	1.3	1.1
	L	1,072	.4	.7	.9	.8	.8
Single Strength Orange Juice	S	54	4.4	5.5	9.5	7.2	4.4
	M	109	2.3	3.0	4.9	3.9	2.5
	L	272	1.1	1.4	2.2	1.8	1.3
Apple							
Canned Apple Slices	S	32	1.8	1.8	4.3	2.6	1.0
	M	64	1.3	1.0	2.3	1.5	.6
	L	96	1.1	.7	1.5	1.0	.5
Canned Apple Sauce	S	32	1.5	1.5	3.6	2.2	.8
	M	64	1.1	.8	1.9	1.2	.5
	L	96	.9	.6	1.3	.8	.4
Canned Apple Juice	S	48	.6	1.7	1.4	2.8	.6
	M	96	.4	.9	.9	1.6	.5
	L	144	.3	.7	.7	1.2	.5

The indicated price effects would be applicable at the plant level assuming each such plant could pass-through price increases. However, plants will face industry pricing competition as they do so. First, larger plants with generally lower per unit cost increases would tend to establish new price levels, and smaller firms could then recover only part of their increased costs. Second, and probably the dominant factor in these industries, the two-thirds of the plants either on municipal systems or those with land disposal systems should be largely unaffected by the guidelines. Third, the price structures of these industries are highly competitive. As a consequence of these conditions, the average industry prices are expected to change only slightly as a direct result of the controls.

Industry prices may also be affected by supply shifts resulting from production curtailments and/or plant shutdowns. In general, there has been underutilization of capacity in these industries except for peak periods; thus, production losses from plant shutdowns (described below) should be picked-up by the remaining segments of the industry, and substantive supply shifts would not be expected.

Based on the above considerations, price increases on an industry-wide basis should be limited at most to the levels determined by the largest producers. BPT controls, then, are generally expected to result in price increases of less than 1 percent, and the BAT controls are expected to result in less than 2 percent price increases.

More precise estimates of industry-wide price changes may be established given relative weights for each type of plant, e.g., number and size distribution of plants and relative volumes of each type of product packed.

A summary of available plant information is presented in Table VII-10 for the citrus and apple processing industries. Based on 1968-70 average production data, the following percentages of raw products were processed:

Type of Product	Relative Raw Product Packed
Citrus - Orange Juice	
Frozen Concentrate O.J.	85%
Single Strength O.J.	15%
	100%
Apples - Canned	
Slices	12%
Sauce	47%
Juice	41%
	100%

Applying the percentages above as weights to large model plants only, average citrus (orange juice) prices for large plants would need to increase from .5 to .8 percent to cover BPT control costs, and from .9 to 1.1 to cover BAT costs. Similarly, large apple processing plants would require weighted average increases in prices from .4 to .9 percent for BPT control and from .5 to 1.3 percent for BAT control. Other weighted averages might be calculated for medium and small plants to determine relative impacts for multiproduct types of plants and industry averages.

Another general concern regarding price (and other) effects of the proposed controls is the accuracy of the estimated pollution abatement costs. To assess the sensitivity of price changes to pollution control costs, the estimated control costs were increased by 50 percent. (Industry representatives expressed that such levels of increase or more were likely for some treatment strategies.) The incremental price increases required to maintain net incomes are shown in Table VII-2 for selected model plants. For example, price increases needed for BAT control in large plants would range from about .3 to .6 percent more among the model cases shown.

B. Financial Effects

Two primary types of analysis were completed to assess the financial impacts of the proposed pollution control costs on the model plants: (1) profitability impacts, and (2) impacts on the present value of future net income streams.

Profitability. The profitability of all plants which are required to add pollution control facilities will be adversely affected. This is indicated in Tables VII-3 and VII-4 for all model plants (assuming no price increases). Net incomes are shown to decrease in direct relation to the pollution control investment and annual operating costs. Also reported are estimates of net income as a percent of sales and the after tax return on investment (ROI) for each model plant under alternative treatment conditions.

Table VII-2. Incremental price increases required by selected model plants [1/] to maintain net income with a 50 percent increase in estimated pollution control costs

Type of Plant	Size	Treatment Alternative				
		BPT		BAT		Both
		B	E	C	F	D
Citrus						
Frozen O.J. Concentrate	S	1.0	1.3	2.1	1.4	1.1
	M	.4	.5	.8	.6	.5
	L	.2	.3	.5	.4	.4
Apple						
Canned apple slices	M	.6	.5	1.1	.7	.3
	L	.6	.4	.9	.6	.3
Canned apple sauce	M	.5	.4	1.3	.6	.5
	L	.5	.3	.6	.5	.2
Canned apple juice	S	.5	.8	.8	1.5	.5
	M	.2	.7	.4	.8	.3
	L	.2	.4	.3	.5	.2

[1/] Plants selected were only those with positive NPV's after original pollution control costs were applied.

Table VII-3. Net profits and return on investment for selected citrus processing plants with and without pollution control costs.

Type of Plant and Treatment Strategy	Small Plants			Medium Plants			Large Plants		
	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)
Frozen Concentrate O.J.									
Base Line	125	4.6	11.2	420	4.4	10.6	948	4.7	12.4
BPT: B	97	3.6	8.0	386	4.1	9.4	903	4.4	11.2
E	89	3.3	6.3	370	3.9	8.4	879	4.3	10.7
BAT: C	66	2.4	5.0	346	3.7	8.1	847	4.2	10.6
F	79	2.9	5.4	358	3.8	8.0	862	4.2	10.4
D	94	3.5	7.7	367	3.9	8.9	863	4.3	10.9
Single Strength O.J.									
Base Line	13	.9	8.6	16	.5	1.3	59	.7	1.7
BPT: B	(36)	<0	<0	(35)	<0	<0	(1)	<0	<0
E	(48)	<0	<0	(50)	<0	<0	(18)	<0	<0
BAT: C	(92)	<0	<0	(93)	<0	<0	(64)	<0	<0
F	(66)	<0	<0	(70)	<0	<0	(40)	<0	<0
D	(35)	<0	<0	(38)	<0	<0	(14)	<0	<0

Table VII-4. Net profits and return on investment for selected apple processing plants with and without pollution control costs.

Type of Plant and Treatment Strategy		Small Plants			Medium Plants			Large Plants		
		Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)
Canned Apple Slices										
Base Line		7	.7	1.2	90	4.4	8.1	144	4.7	9.0
BPT:	B	(10)	<0	<0	77	3.8	6.8	126	4.1	7.8
	E	(8)	<0	<0	79	3.9	6.4	133	4.3	7.7
BAT:	C	(34)	<0	<0	67	3.3	5.8	118	3.9	7.3
	F	(17)	<0	<0	75	3.7	6.0	128	4.2	7.3
	D	0	<0	<0	85	4.2	7.5	136	4.4	8.3
Canned Apple Sauce										
Base Line		4	.3	.7	90	3.7	9.8	138	3.8	9.2
BPT:	B	(12)	<0	<0	77	3.1	8.3	120	3.3	7.9
	E	(12)	<0	<0	80	3.3	7.8	127	3.5	7.9
BAT:	C	(38)	<0	<0	67	2.7	7.1	114	3.1	7.4
	F	(21)	<0	<0	75	3.1	7.2	122	3.3	9.1
	D	(4)	<0	<0	85	3.5	7.5	131	3.6	8.6
Canned Apple Juice										
Base Line		21	3.3	7.6	107	8.4	21.1	175	9.1	24.0
BPT:	B	19	3.0	6.8	105	8.3	20.4	172	9.0	23.5
	E	14	2.2	4.1	101	8.0	17.4	168	8.8	20.8
BAT:	C	16	2.5	5.8	102	8.0	19.7	168	8.8	22.7
	F	9	1.4	2.6	97	7.6	16.3	164	8.6	20.0
	D	19	3.0	6.7	104	8.2	20.0	170	8.9	22.9

As shown in the tables, all single strength orange juice model plants (small, medium and large) are shown to have negative net incomes after pollution control costs are added. Such plants, plus at least small plants with this product line, are expected to be impacted severely. As discussed further below, such plants are expected to close. Further, small processors of apple slices and apple sauce are projected to be severely impacted.

Net profits and rates of return on investment for the model plants are as presented in Tables VII-3 and VII-4 for the estimated pollution control cost levels. Comparative estimates are shown in Tables VII-5 and VII-6 for 50 percent increases in pollution control costs for selected plants. After-tax net incomes are typically not reduced dramatically relative to the original level control costs, primarily because pollution control costs are tax deductible. Therefore, the incremental burden is effectively less than that implied by the 50 percent increase, e.g., about half or 25 percent for most plants.

Net Present Value (NPV). Another measure of the financial viability of a plant is the net present value (NPV) of projected streams of costs and revenues. This measure assesses the likelihood of continued plant operation versus closure. By discounting at the cost of capital rate (see Chapter V), then positive NPV's would indicate the likelihood of continued plant operation; negative values indicate probable plant shutdowns. To complete this analysis, the following assumptions were made:

1. Existing plants have sunk investments that could be scrapped or salvaged and the salvage value reinvested elsewhere as an alternative to the processing operation. However, only 10 percent of the estimated replacement cost of a citrus or apple processing plant is assumed recoverable. This relatively low value assumes little opportunity for equipment use outside the industry and on low prospects for use as replacement equipment in existing plants. Industry buildings are typically older buildings and are not well suited for other uses.

2. Revenues and expenses are assumed to remain constant over time, i.e., 20 years of operation.

3. The estimated cost of capital for the industry is 6.0 percent after taxes (see Page V-8).

Table VII-5. Net profits and return on investment for selected citrus processing plants with a 50 percent increase in pollution control costs

Type of Plant and Treatment Strategy		Small Plants			Medium Plants			Large Plants		
		Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)
Frozen Concentrate O.J.										
BPT:	B	84	3.1	6.6	368	3.9	8.8	881	4.3	11.1
	E	71	2.6	4.5	345	3.6	7.4	843	4.2	10.0
BAT:	C	37	1.4	2.6	308	3.3	7.0	800	3.9	9.7
	F	57	2.1	3.5	326	3.4	7.0	818	4.0	9.5
	D	79	2.9	6.2	341	3.6	8.1	820	4.0	10.2

Table VII-6. Net profits and ROI for selected apple processing plants with a 50 percent increase in pollution control costs

Type of Plant and Treatment Strategy		Small Plants			Medium Plants			Large Plants		
		Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)	Net Income ($000)	Net Inc. % Sales (%)	After Tax ROI (%)
Canned Apple Slices										
BPT:	B		1/		70	3.4	6.2	117	3.8	7.2
	E				75	3.7	5.8	127	4.1	7.1
BAT:	C				55	2.7	4.7	106	3.5	6.4
	F				67	3.3	5.2	119	3.9	6.6
	D				81	4.0	7.0	132	4.3	8.0
Canned Apple Sauce										
BPT:	B		1/		70	2.9	7.5	111	3.0	7.3
	E				75	3.1	6.9	121	3.3	7.3
BAT:	C				55	2.2	5.7	102	2.8	6.6
	F				67	2.7	6.0	115	3.1	6.8
	D				81	3.3	8.5	127	3.5	8.3
Canned Apple Juice										
BPT:	B	17	2.7	6.1	103	8.1	20.0	170	8.9	23.1
	E	10	1.6	2.7	97	7.6	15.6	164	8.6	19.3
BAT:	C	12	1.9	4.2	99	7.8	18.9	165	8.7	22.1
	F	2	.3	.5	91	7.2	14.4	158	8.3	18.2
	D	17	2.7	5.9	102	8.0	19.4	168	8.8	22.4

1/ Plants omitted since closure is assumed to have occurred at original level, therefore there is no need to consider at 50 percent increase level.

The net present values were calculated for model plants both with and without pollution controls. These results are shown in Table VII-7.

As indicated, all model plants without pollution controls had positive net present values. They would--without controls--likely continue to operate rather than dispose of their facilities and reinvest elsewhere. However, with pollution controls, specific types and sizes of plants are likely to shutdown. (Alternative treatment strategies vary the degree of probability.)

The most severely impacted type of plant is the single strength orange juice plant; such small, medium and large plants would probably close given either the B-C or the E-F treatment strategies. Only the large plant would continue under the D strategy (land spray irrigation).

In the apple processing industry, the small canned apple juice and the small canned apple sauce plants would be expected to shutdown--regardless of treatment strategy. All remaining types of plants would be expected to continue operations under the assumptions indicated.

A sensitivity analysis of NPV's was completed for selected model plants assuming a 50 percent increase in pollution control costs. The results are reported in Table VII-8 for those model plants which had positive NPV's with the original pollution control costs. Only one additional type of plant, the small, canned apple juice plant would probably close under the high cost E-F treatment strategy. Thus, for up to 50 percent higher costs, very few additional closures are expected.

Another special analysis was made to determine if any of the plants which were projected to close would remain open to 1983 only. That is, would a plant possibly meet the BPT guidelines in 1977 but close in 1983 rather than meet the BAT guidelines? In this case, only the large, single strength orange juice plant would likely do so. The most probable treatment strategy would be alternative B.

Table VII-7. Net present values of selected citrus and apple processing model plant cash flows with and without pollution controls

	Net Present Value			Treatment Strategy		
	Size		W/O	BPT BAT	BPT BAT	Land
	Class	Tons/Day	PC	B----C	E----F	D
			($1000)			
Citrus						
Orange Juice, Frozen Concentrate	S	144	1,507	816	735	1,059
	M	528	5,880	5,003	4,818	5,116
	L	1,072	13,278	12,100	11,801	12,053
Orange Juice, Single Strength	S	54	159	(905) 1/	(903)	(426)
	M	109	285	(813)	(845)	(368)
	L	272	964	(68)	(138)	280
Apples						
Canned Apple Slices	S	32	90	(294)	(259)	(5)
	M	64	1,226	982	964	1,148
	L	96	1,947	1,679	1,675	1,840
Canned Apple Sauce	S	32	61	(334)	(299)	(45)
	M	64	1,350	1,106	1,093	1,272
	L	96	1,961	1,686	1,682	1,854
Canned Apple Juice	S	48	252	206	73	224
	M	96	1,369	1,316	1,199	1,321
	L	144	2,230	2,159	2,041	2,163

1/ Parentheses denote negative, NPV's and, thus, probable plant closures.

Table VII-8. Net present values of selected model plant cash flows with a 50 percent increase in pollution control costs

		Treatment Strategy (With + 50% Costs)		
	Size	BPT BAT B ----C	BPT BAT E ---- F	Land D
		-----------------	-($1000)-	-----------------
Citrus				
Orange Juice, Frozen Concentrate	S	484	210	839
	M	4,654	4,284	4,740
	L	11,514	11,051	11,439
Apples				
Canned Slices	M	855	833	1,092
	L	1,548	1,536	1,753
Canned Sauce	M	979	957	1,216
	L	1,562	1,550	1,807
Canned Juice	S	172	(26) 1/	203
	M	1,273	1,112	1,298
	L	2,129	1,942	2,136

1/ Parentheses denote negative NPV's and, thus, probable plant closure.

C. Production Effects

The citrus and apple processing industries have generally experienced slight to moderate rates of growth during the past decade in terms of physical volumes packed. An exception has been the canned apple slice industry (and whole apples) which has declined in volume packed. A summary of recent pack data for the principal products in this analysis is shown in Table VII-9. More detailed data are presented in Chapter II.

A summary of available plant data regarding both the citrus and apple processing industries is presented in Table VII-10. In 1972, 105 plants processed citrus products although only 41 were solely citrus processors. The remaining 64 plants also processed other fruit and/or vegetable products. Plants involved with citrus processing are typically multiproduct plants. (Further descriptions of citrus processors are reported in Tables II-19 and II-20.)

Also in 1972, 144 plants processed canned or frozen apple products. Twenty-nine (29) plants packed only apple products, while the remainder were about equally distributed as fruit-only and as fruit and vegetable processors. The most prevalent apple-products-only plants were plants processing cider and juice (8), slices (4), cider (4), and sauce, cider and juice (4). The majority produced multiple products, however. (See Tables II-25 and II-26.)

Also shown in Table VII-10 are estimated distributions of citrus and apple processing plants by size category and by the estimated volume of pack by each size category of plants. It is noted that small plants comprise a relatively small portion of total industry pack; consequently, small plant closures usually do not substantially affect industry-wide patterns (production losses can be made-up by larger plants). Local economic impacts can be severe, however. These factors are discussed further below.

Table VII-9. Summary of recent pack data for selected citrus and apple products

Type of Product	Units	Annual Pack 1968	1969	1970	1971
Citrus					
Frozen Concentrate, Orange Juice	1,000 gal.	83,697	108,043	126,402	125,187
Canned Orange Juice	1,000 cases	15,691	17,082	16,966	N.A.
Apples					
Apple Slices (& Whole)	1,000 cases	3,604	3,128	2,271	N.A.
Apple Sauce	1,000 cases	24,073	27,533	23,647	N.A.
Apple Juice	1,000 cases	9,641	13,503	14,472	N.A.

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1972, Edward E. Judge & Son, Inc., Westminster, Md., 1972.

Table VII-10. Summary of estimated plant numbers and volumes packed by size category for the citrus and apple processing industries

Type Plant	Size Category [1]			
	Small	Medium	Large	Total
Citrus				
Citrus Only	--	--	--	41
Citrus plus other	--	--	--	64
Total citrus	36	43	26	105
Approx. Volume Packed _/	10%	30%	60%	100%
Apples				
Apples only	--	--	--	29
Apples plus other	--	--	--	115
Total apples	63	42	39	144
Approx. Volume Packed	5%	40%	55%	100%

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[1] Size categories here are defined to include total pack of all products processed. Therefore, these sizes are larger than the single-product model plant categories as defined. Based on Judge, the size ranges for these plants are as follows:

Small ≤ 500,000 canned cases or 10 million frozen pounds

Medium = 500,000 to 5 million canned cases or 10-100 million frozen pounds

Large ≤ 5 million canned cases or 100 million frozen pounds

Source: The Directory of the Canning, Freezing, Preserving Industries, 1972-73, Edward E. Judge & Son, Inc., Westminster, Md., 1972.

Baseline Closures

There has been a general decline in the number of fruit and vegetable canning and freezing plants throughout the U.S. in recent years. For example, Census of Manufacturers data for the most recent census years indicates the following numbers of fruit and vegetable canning and freezing plants:

Year	Canners	Freezers
1958	1,630	303
1963	1,422	650
1967	1,223	608

The overall rate of decline in canning plants from 1958 to 1967 was about 2.8 percent per year. For freezers, the decline from 1963 to 1967 was about 1.6 percent per year.

More recent data compiled from The Directory of the Canning, Freezing and Preserving Industries, by Edward E. Judge, for 1970-71 and 1972-73 indicate that the overall rate of decline for both canners and freezers may have decreased in the 1970-72 period. From this source it was estimated that 183 plants closed from 1970-72; but, also, that 151 new fruit and vegetable canning and freezing plants were opened (or newly listed). Thus, a net loss of only 32 plants was recorded between 1970 and 1972. This represented only a 1.3 percent net decline per year for both canners and freezers --some plants may have existed prior to 1970 but were first reported in The Directory in 1972, actual net losses would be greater than the 1.3 percent per year.

As suggested, conclusive baseline plant closure data are not readily available. In our judgment, net plant closures are estimated to be between 2.8 and 1.3 percent per year for both fruit and vegetable canners and freezers, e.g., 2 percent per year. It is also noted that the productive capacity of this composite industry has probably increased despite net losses in plant numbers. New plants are typically larger than old plants which have closed across all product classes.

Using the 2 percent estimate as a basis for projecting baseline plant closures in this analysis (prior to enforcement of pollution controls), then the following summary of annual closures is projected:

Type of Processor	Present No. of Plants	Baseline Annual Closures [1]	
Citrus			
Citrus only	41	1	(0.82)
Citrus plus other	64	1	(1.28)
Total	105	2	(2.10)
Apples			
Apples only	29	1	(0.58)
Apples plus other	115	2	(2.30)
Total	144	3	(2.88)

---

[1] Closure estimates would decrease slightly over time as "present" numbers of plants decline.

Again, these estimates are projected annual net losses. Too, while plant closures may occur among all size segments of plants, the greatest losses are expected to occur among the small size categories.

The above annual projections of plant closures can be extended to yield the following baseline estimates for 1977 and 1983 as follows:

Type of Processor	Total Baseline Plant Closures 1973-77	1977-83	1973-83
Citrus	8	10	18
Apples	12	13	25
Total	20	23	43

Plant Shutdowns Resulting From Pollution Control Guidelines

Based upon the above financial analyses, three basic groups of model plants are highly subject to shutdown if the increased burden of pollution control costs are not offset by price increases:

1. single-strength orange juice plants (small, medium and large)
2. small apple slice plants
3. small apple sauce plants

All other model plants remained "viable" with added pollution control costs -- including treatment strategies B to C, E to F and D as described. (Note E to G was similar to the E to F alternative and not repeated. The impacts would be from 5 to 10 percent greater and conclusions would be generally the same as for the E to F alternative.) Furthermore, based on sensitivity analysis using increased pollution control costs of +50 percent, the expected shutdowns were basically the same (small canned apple juice plants would also likely shutdown under the E to F control alternative; otherwise the same results apply).

It is noted, also, that the plants would, in general, close in 1977 (BPT level) rather than continue to 1983. Consequently, plant shutdowns due to pollution controls--and above the baseline case--are both limited in scope and expected during the initial enforcement period (1977).

Citrus Plant Closures Above Baseline. A review of Judge's The Directory for 1972-73 indicates only 5 single-strength, canned citrus juice processors producing only canned juice in the small, medium and large model plant categories. One other plant was a very large operation that was assumed to have adequate economies of scale to continue. In other words, 5 plants are expected to shut down by 1977 if treatment facilities must be installed. However, some other prior assumptions lead to the following implications:

- 1 plant closure attributed to baseline conditions;
- 2 plants probably already on municipal or land disposal systems;
- 2 remaining plants shut down due to pollution controls.

Another group of plants (6) were estimated to be single-product, frozen concentrate citrus processors. However, these plants are not expected to shutdown based on model plant results. Further, the remaining citrus plants--both citrus-only and citrus-plus-other--are multiproduct plants. While model plants did not specifically cover these plants, obviously, any combination of products is relatively better than the single strength juice model case. Except for baseline closures, no additional plant shutdowns can be conclusively projected at this time.

In conclusion, two basic types of shutdown impacts on the citrus industry are expected:

1. All 18 projected baseline citrus plant closures from 1973 to 1983 are expected to occur by 1977 (subsequent to BPT guidelines). This includes 10 plants which were projected to operate beyond 1977. Most of the baseline plant closures are expected to involve relatively small operations.

2. Single strength citrus juice plants are expected to be impacted most severely. Only 5 applicable operations were identified. Based on assumed treatment systems in place and baseline conditions, a net closure of only 2 plants is projected due to pollution controls.

Apple Processing Plant Closures Above Baseline. As noted above, only small apple slices and sauce processing plants are expected to be severely impacted due to BPT and BAT controls. Based again on data from The Directory, only about 14 plants fall into the small category as defined by the model plants of this study. This includes small plants which produce slices, sauce, slices and sauce, and limited other products.

Again not all 14 plants will necessarily close due to controls, and the following breakdown is projected:

- 2 plant closures due to baseline conditions,
- 8 plants probably already on municipal or land disposal systems,
- 4 remaining plants shutdown due to pollution controls.

As shown in Table VII-10 there are a total of 63 small apple processing plants. However, beyond the above shutdowns and expected baseline closures (25 primarily small) the model plant results do not conclusively indicate that other forced shutdowns are expected. Additional multiproduct model plant cases would be desired, but virtually all plants produce unique combinations of pack.

As stated similarly for citrus, there are two basic types of shutdown impacts which are expected in the apple processing industry:

1. Baseline closures will occur more rapidly. In this case, all 25 projected 1973-83 baseline closures are expected by 1977 following BPT guidelines enforcement. This includes 13 plants which were projected to operate beyond 1977.

2. A total of 4 additional small plant closures are expected to shutdown due to the added financial burden of pollution controls. Eight to ten other small plants (primarily apple slices and sauce) would be impacted severely, but it is estimated that treatment systems are already in place.

Total Production Lost Due to Guidelines

The estimated short-term production lost from the 2 citrus juice plants which are forced to shut down due to the control guidelines is 6 percent of the total single-strength output. This percentage loss should be recoverable among existing and underutilized plants within a short time.

The 4 apple products processing plants expected to close are small plants and their total production loss is approximately 4 percent of the apple slices and sauce output. Again, this percentage loss should be picked-up by other processors.

On an industry-wide basis, the primary forced shutdown production losses should be recoverable. However, the baseline rapid-closure pattern expected in 1977 will cause more serious adjustment problems in the industry. For example, in 1977 with fewer plants, the 10 citrus remaining baseline closures would represent about 11 percent of the plants in the citrus industry.

Also in 1977, the remaining baseline closures of 13 apple products plants would represent about 10 percent of the total apple processors. Total production loss should be substantially lower than these percentages since most plant closures are expected to be among small plants. However, the adjustment problems could be serious both in terms of short-term production and local community and employment impacts.

D. Employment Effects

Total employment in 1972 in the citrus processing industry was estimated at about 18,615 and at 25,155 in the apple products processing industry. Approximate estimates of 55, 145 and 400 employees have been made for small, medium and large plants, respectively in each of these industries. (The above estimates reflect "average monthly" employment per plant only. Peak season employment is often 2 to 2.5 times larger with part-time employees added to meet seasonal requirements.)

For the two forced shutdowns in the citrus industry (beyond baseline), the employment losses would represent less than 1.5 percent of the industry employment (one medium and one small plant assumed). In the apple processing industry, the four small plant closures would represent less than .5 percent of the total employment.

Again, it is emphasized that the rapid closure of "baseline" plants in 1977 will present adjustment problems which can only be partially attributed to pollution control impacts.

Employment displacements in these industries are not expected to be absorbed by more than about 10 percent in the remaining plants in the industry. Most remaining plants will tend to be relatively capital intensive. Some additional skilled labor may be transferable--but additional production workers, if needed, would tend to come from local labor forces.

Employment on farms (orchards) is not expected to change significantly on the assumption that alternate processors will be available within a feasible delivery range. If alternate processors are not available, serious orchard losses and associated farm employment reductions would occur.

E. Community Effects

Citrus and apple processing plants often are a vital economic factor in the communities in which the plants are located. Thus, while only a few plants are expected to close, local impacts could be severe.

In information developed by the National Canners Association pertaining to some 400+ fruit and vegetable processing plants which might close in the future because of pollution controls, the following "average" characteristics were derived for each plant closure situation:

- 63 full time employees involved
- 72 part time employees involved
- 33 farmers affected
- $700,000 local payrolls, expenditures involved
- $1.4 - 2.1 million local economic activity (multiplier effect) involved
- 50 percent of such plants in or near towns with less than 2,500
- 75 percent of such plants in or near towns with less than 5,000

From this general information, the approximate levels of local community effects can be assessed.

The exact location of the plants which are most likely to close has not been established. However, it is noted that the principal citrus producing areas are in Florida, Texas, California and Arizona. Major apple producing and processing areas are in New York, Michigan, Maryland, Pennsylvania, Virginia, California, Washington, Cregon and Idaho. More information on plant location is included in Chapter II.

F. Other Effects

A potential concern exists regarding international trade and balance of payments consequences of pollution control impacts on the citrus and apple processing industries. For example, 41.5 percent of the 1970 pack of canned orange juice (single strength and concentrated) was exported; thus, any major reduction in production could result in losses of exports and in a declining balance of trade. However, as estimated above, production levels of single strength orange juice are expected to be maintained (despite a loss of 6 percent from plants which are forced to shutdown).

On the other hand, the U.S. is a net importer of processed apple products e.g., apple juice, which represented about 45 percent of the U.S. pack in 1970. In this case, only apple slices and sauce processing plants were expected to be impacted. Thus, no major international trade implications are involved. However, product mixes could vary and relatively more or less apple juice could be produced. Any substitution from juice to sauce or slices could result in increased apple juice imports and a net decline in the balance of trade. More detailed export and import data are presented, by product in Chapter IV.

G. Summary of Impacts

The foregoing analysis of the citrus and apple processing industries indicates that specific segments of these industries are likely to be impacted severely on the basis of model plant effects. A broad range of effects were considered and a brief summary of the main effects estimated for both BPT and BAT levels of control is as follows:

Type of Impact	BPT (1977)	BAT (1983)
1. Price Effects		
Orange Juice - large plants	.5 - .8%	.9 - 1.1%
Apples - large plants	.4 - .9%	.5 - 1.3%
2. Financial Effects	All S.S. Orange Juice and small apple slices and sauce plants incur losses. Plant shutdowns expected.	Same as BPT
3. Production Effects		
. Citrus plant shutdowns		
Baseline	8	10
Above Baseline	2(+10 Baseline)	-
. Apple plant shutdowns		
Baseline - No. plants	12	13
Above Baseline - No. Plants	4(+13 Baseline)	-
. Production losses (short-term)		
Citrus - Above Baseline	6%(+Baseline)	
Apples - Above Baseline	4%(+ Baseline)	
4. Employment Effects		
Citrus - Above Baseline	1.5%(+Baseline)	
Apples - Above Baseline	.5%(+Baseline)	
5. Community Effects		
Citrus and apples	Employee losses Payroll losses Local multiplier effect loss Farmer impact possible	
6. Other Effects		
Citrus	Potential loss in exports of canned juice	
Apples	Potential increase of imports of apple juice	

VIII. LIMITS OF THE ANALYSIS

The foregoing impact analysis was based upon data and information from published secondary data, annual company reports, financial statistics services, private sources and the Contractor's files. The various data are subject to error and variance. The purpose of this final section is to present the limits of the analysis in terms of accuracy, range of error, and critical assumptions. The section also indicates remaining questions to be considered.

A. General Accuracy

Key financial information on the fruit and vegetable industry is generally scarce, particularly for individual plants or firms. Consequently, the financial aspects of the impact analysis were, of necessity, based upon synthesized costs and returns for model plants representing the various segments studied. In developing these model data, efforts were devoted to evaluating and cross-checking these materials wherever possible.

Fruit and vegetable processing plants usually process a mix of products and product forms. For example, apple processors will often produce apple juice, sauce, and slices as well as other fruit products such as peaches and pears. Vegetable plants are virtually always multiproduct processors. Too, some multiproduct processors handle relatively large volumes.

The characteristically multi-product plant makes it difficult to model the various industry segments. To handle this situation, plant models were developed on a single-product basis, sized to typical throughputs of that product. It is recognized that this procedure may not fully reflect cost savings through the use of common facilities by several products.

Due to severe budget constraints and insufficient financial data, this analysis used frozen and single strength orange juice plants to represent the citrus oil, sections, and peel products segments. The procedure may have reduced the accuracy of the impact analysis, but it is believed that the inferences drawn are acceptably accurate.

Specifications of the contract called for the Contractor to use effluent control costs provided by EPA. The contract precluded detailed comment on these costs and technology by this Contractor. The cost data provided were for two discrete plant sizes which did not correspond with plant sizes used in this analysis. Linear extrapolations of the provided cost data were made by the Contractor to obtain the needed data. It is quite conceivable that the cost-size relationships may be non-linear, but information on this was not provided. To the extent that this relationship deviates from a linear one, the effluent control costs used in the model plant analysis may be misstated.

B. Possible Range of Error

Different data series and portions of the results of the impact analysis are subject to error and variance with the industry. Estimated error ranges of key items as an order of magnitude, are as follows:

		Error range (Pct.)
1.	Number, location, capacity, product mix of plants	± 10
2.	Price data for products and raw materials	± 10
3.	Sunk investment value	± 20
4.	Plant operating costs	± 10
5.	Effluent control costs	Not estimated
6.	Expected price changes	± 5
7.	Estimated plant closures	± 20

C. Critical Assumptions

In an analysis of this sort, a number of underlying assumptions are required. Some of the more critical assumptions used in this analysis are given below:

1. As indicated in the above discussion on general accuracy, single product model plants were used as the basis of the analysis. It was assumed that they would be indicative of the reactions of corresponding multiproduct units.

2. It was further assumed that frozen and single strength orange juice plants would adequately reflect other citrus products--sections, oil, and peeled products.

3. Linear cost-size relationships of effluent control investment and annual costs were assumed in estimating these costs for the model plants.

4. Constant 1972 prices and costs were used for each of the model plants for the period of analysis. This is based upon the assumption that inflation will influence both proportionately. There is some evidence that effluent control costs are rising at a rate faster than the general price level; thus, the 1977 and 1983 effluent control investment costs may be understated.

5. Plant throughput was held constant for the period of analysis, although the various types of plants varied in length of operating season (Table III-1). In practice, it should be recognozed that due to weather conditions, crop quality, and other factors, year-to-year variations of throughput will occur.

6. Based on sample data of the various industry segments, approximately two-thirds of the plants were assumed to have either existing municipal system hookups or land-irrigation disposal systems in place that would meet BAT standards. Only the remaining third with partial or no treatment facilities would require additional investment to meet BPT and/or BAT. (See Table VI-10 for summary.)

7. Alternative effluent control technologies were provided by EPA, along with a set of assumptions regarding the number of plants that would employ each type of technology. The

schedule of BPT and BAT technology (including further municipal hookups) is presented in Table VI-10. The impact analysis was based upon these assumptions. It turns out, in most cases, that the conclusions regarding impact of the effluent controls are similar for each of the alternative technologies.

8. Cost data were not provided regarding new municipal hookups by these fruit and vegetable plants. Since data were not provided, the number of plants assumed to follow this alternative were excluded from the closure estimates. To the extent these hookups would involve substantial new costs, estimated potential closures may be understated.

D. Remaining Questions

The use of the model plant approach obviously results in questioning its representativeness. Although any rigorous analysis of the type this report reflects would require the use of representative plants, given a larger budget the analyst could construct more models and perhaps better reflect the economics of the industry. The question of representativeness of the model plants can only be answered by further detailed analysis.

Although several treatment strategies were examined, land-based technologies were predominant. If land is unavailable or its costs prohibitive, high land costs could lead to a greater impacts than are estimated in this report. Answers to these questions would require further industry surveys.

Another unresolved question as of this writing is the impact of effluent controls on the potato processing segment. As previously pointed out in the Phase I report and subsequent memos from the contractor to EPA, the required financial data for this segment are virtually non-existent. Efforts to obtain and/or synthesize these data have proven unsuccessful. Given this situation, it is suggested that the best alternative, short of an extended project, to estimate pollution control cost impacts would be a comparison of unit effluent control costs with wholesale prices.

Because many fruit and vegetable processing plants process a number of products that were not included in the proposed effluent limitations guidelines, an obvious question arises as to what constitutes an apple or a citrus processing plant. Presumably some sort of concentration ratio would have to be established. This difficulty, of course, gave rise to the problems of estimating the industry economics discussed above.

APPENDIX A

Preliminary Potato Processing Industry Economic Impact of Costs of Proposed Effluent Limitation Guidelines

An unresolved question is the expected economic impact of effluent controls on the potato processing industry. Proposed effluent guidelines have been established, and estimated investment and operating costs for specified plants have been developed. However, plant financial data to which the incremental pollution control costs would apply were not available from secondary sources nor obtainable by DPRA from extensive contacts with trade association and private industry sources.

A preliminary insight into expected impacts of pollution control costs is possible by comparing unit effluent control costs with wholesale prices of processed potatoes. The purpose of this brief summary is to estimate both unit costs and prices and to derive a cost/price ratio which would indicate the general magnitude of price increase required to cover the incremental pollution control costs.

In this assessment, two major subcategories of potato processing operations are involved:

1. Frozen potato products
2. Dehydrated potato products

These subcategories represent the major potato processing categories. For example, in 1970, all processed potatoes were distributed approximately as follows in terms of fresh weight equivalent:

Process	1970 % Distribution
Frozen	47%
Dehydrated	30
Chips	22
Canned	1
Total Processed	100%

Further the ratio of processed to fresh potato consumption has been steadily increasing with a 50/50 ratio occurring in 1970. By 1980, it is estimated that processed products will account for about three-fourths of the total food use of potatoes (Figure A-1).

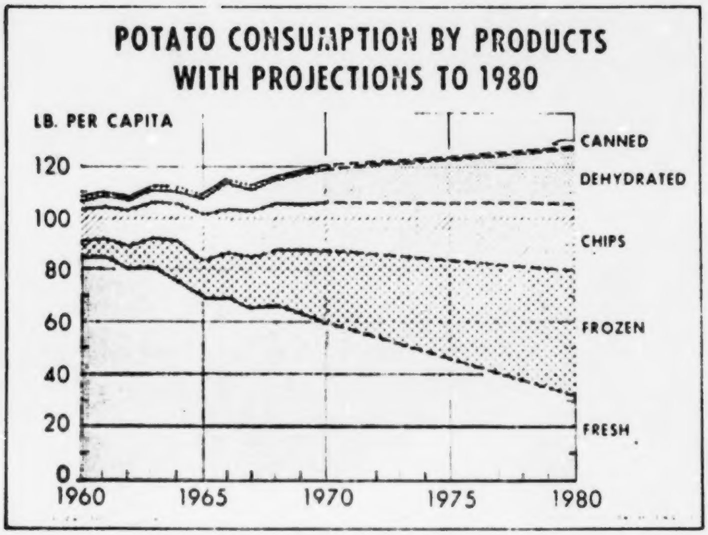

Figure A-1

Source: Vegetable Situation, ERS, USDA, TVS-186, October, 1972

Within the frozen potato category, frozen french fries are the dominant product packed (85-90%). The balance includes hash browns (5-7%) and miscellaneous other products (5-8%).

A variety of dehydrated potato products are also produced, e.g., granules, flakes, slices, and diced potatoes. A percentage breakdown of these products is not known at this time, but granules are a major product.

Water Pollution Control Costs

In information supplied by EPA (Ben Holt Co.), water pollution control standards (see Tables VI-1 and VI-2) and associated treatment costs were provided for both the frozen potato and the dehydrated potato products categories. A summary of the estimated pollution control costs as provided shown in Table A-1. For each process category, costs are shown for two sizes of operations as specified. Also, both estimated investment and annual operating costs are shown. Further, a series of alternative treatment strategies are proposed: B and E are BPT alternatives; C, F and G are BAT alternatives; and D provides both BPT and BAT control.

For reference, an outline description of the treatment components involved in each alternative strategy are as indicated in Table A-2. It is noted that the following combinations of treatment strategies are designed to first provide BPT and then BAT levels of control. B to C; E to F or G; and D (spray irrigation) for both BPT and BAT control.

One objective is to derive pollution control cost estimates in terms of units (e.g., cwt.) of product packed. To do so, the following operating assumptions were made:

Operating Characteristic	Assumption
1. Conversion factor from raw product to processed weight: [1]	
a. Frozen products	.4
b. Dehydrated products	.14
2. Operating days per year	250
3. Thruput per day (raw product)	Same as provided

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[1] Conversion factors based on: Conversion Factors and Weights and Measures, for Agricultural Commodities and Their Products, Statistical Bulletin No. 362, USDA, ERS, June, 1965.

Table A-1. Summary of investment (I) and annual cost (AC) data for water pollution control for selected potato processing plants[1]

Treatment Practice and Type Cost		Frozen Potato Products Plant Data		Dehydrated Potato Products Plant Data	
		400TPD(S) ($000)	1,000TPD(L) ($000)	350TPD(S) ($000)	1,000TPD(L) ($000)
Treatment B:	I	505.2	1,051.0	273.3	586.9
	AC	100.7	188.9	49.6	113.0
Treatment C:	I	728.2	1,525.0	383.3	842.9
	AC	144.5	273.6	75.4	162.0
Treatment D:	I	469.1	1,140.3	217.1	555.1
	AC	94.8	246.5	41.6	114.1
Treatment E:	I	902.2	1,826.0	498.3	1,011.9
	AC	67.0	151.7	32.6	80.0
Treatment F:	I	1,009.2	2,038.0	559.3	1,131.9
	AC	81.9	176.2	42.7	96.2
Treatment G:	I	1,089.2	2,213.0	599.3	1,223.9
		99.9	211.2	53.7	116.2

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[1] Data provided by EPA. Supplement Tables 33 and 34 to the Development Document prepared by the Ben Holt Co., pp. 145 and 146.

Table A-2. Summary of treatment components for alternative strategies of effluent reduction: Frozen Potato Products and Dehydrated Potato Products

Treatment Component	Alternative Strategies for Frozen Potato Products						Alternative Strategies for Dehydrated Potato Products					
	B	C	D	E	F	G	B	C	D	E	F	G
Screening (Level A)	X	X	X	X	X	X	X	X	X	X	X	X
Primary Sedimentation	X	X	X	X	X	X	X	X	X	X	X	X
Shallow Lagoon (30 day rentention)		X	X					X	X			
Aerated Lagoon -- Settling	X	X				X	X	X				
Aerated Lagoon -- No Settling	X	X						X				
Anaerobic/Aerobic Lagoon	X	X					X	X				
Activated Sludge				X	X	X				X	X	X
Sand Filtration					X	X					X	X
Spray Irrigation			X						X			

Source: EPA and the Ben Holt Co., Inc. Levels B and E are alternative BPT control strategies, levels C, F and G are alternative BAT control strategies, level D provides both BPT and BAT effluent reductions.

Given the pollution control costs as shown in Table A-1 and the operating assumptions above, the estimated control costs per unit (cwt.) of final product for selected frozen potato and dehydrated potato processing plants are as shown in Table A-3. Investment costs were converted to an annual basis by including depreciation and interest costs as noted in the table.

The control costs in Table A-3 are subsequently summarized by product category in terms of BPT and BAT treatment strategies. The unit costs shown are the basic matrix of cost components required for the proposed unit control cost/wholesale value ratio analysis.

Estimated Wholesale Values

Wholesale prices (or f.o.b. plant prices) for frozen and dehydrated potato products are neither publicly reported nor available. Large institutional buyers, food chains and secondary processors (e.g. General Foods) often negotiate contracts with potato processors and such contracts are confidential. Thus, it is difficult to estimate wholesale values for either frozen or dehydrated potato products.

This study contacted selected institutional buyers in the Mid-West and solicited prices paid for various processed potato products. The results of these inquiries are not purported to reflect industry-wide averages. However, the general magnitude of prices per hundredweight for frozen and dehydrated potato products are considered acceptable for this very preliminary assessment.

A summary of estimated "average" values for selected frozen and dehydrated potato products and relative weights for calculating composite values is as follows:

Process and Product	Sample "Average" 1972 Value/lb	Relative Weight
Frozen Potato Products		
French Fries	.17	90%
Hash Browns	.20	5%
Other	.18	5%
Dehydrated Potato Products		
Granules, Flakes	.28	75% [1/]
Other	.40	25%

[1/] Assumed relative weights for dehydrated products.

Table A-3. Summary of estimated water pollution control costs per unit of final product for selected frozen potato and dehydrated potato products plants

Item	Frozen Potato Products		Dehydrated Potato Products	
	Small Plant	Large Plant	Small Plant	Large Plant
TPD Raw Product [1/]	400	1,000	350	1,000
TPY-Annual Raw Product [2/]	100,000	250,000	87,500	250,000
TPY-Finished Product [3/]	40,000	100,000	12,250	35,000
Pollution Control Costs, [4/] $ per swt.				
Treatment Alternative and Cost Component				
B: Depreciation	.042	.035	.074	.056
Interest	.051	.042	.089	.067
Operating Cost	.126	.094	.202	.161
Total cost/cwt.	.22	.17	.37	.28
C: Depreciation	.061	.051	.104	.080
Interest	.073	.061	.125	.096
Operating Cost	.181	.137	.308	.231
Total cost/cwt	.32	.25	.54	.41
D: Depreciation	.039	.038	.059	.053
Interest	.047	.046	.071	.063
Operating Cost	.119	.123	.170	.163
Total cost/cwt.	.21	.21	.30	.28
E: Depreciation	.075	.073	.127	.096
Interest	.090	.061	.153	.116
Operating Cost	.084	.076	.133	.114
Total cost/cwt.	.25	.21	.41	.33
F: Depreciation	.084	.068	.153	.108
Interest	.101	.082	.183	.129
Operating Cost	.102	.088	.174	.137
Total cost/cwt.	.29	.24	.51	.37
G: Depreciation	.091	.074	.163	.117
Interest	.109	.089	.196	.140
Operating Cost	.125	.106	.219	.166
Total cost/cwt.	.33	.27	.58	.42

[1/] TPD equals Tons Per Day. Sizes provided by EPA and the Ben Holt Co.

[2/] TPY equals Tons Per Year. Based upon 250 operating days per year.

[3/] Finished product yields based on conversion factors from raw product of .4 for frozen products and .14 for dehydrated potato products.

[4/] Basic investment and annual operating cost data as provided. Depreciation calculated as .067 times investment, Interest as .08 times one-half of total investment, and Operating Cost as given divided by cwt. of finished product.

For purposes of this analysis, composite (weighted) wholesale values per hundredweight unit of processed potatoes are estimated as:

	Composite Wholesale Value/cwt.
Frozen potato products	$17.20
Dehydrated potato products	$31.00

Comparison of Unit Control Costs and Wholesale Values

The results of the two preceding sections can now be combined to approximate the percent price increase required to recover the costs for water pollution control:

$$\text{Approximate Percent Price Increase} = \frac{\text{Control Cost/cwt}}{\text{Wholesale Value/cwt}}$$

This ratio can be computed for both small and large plants, and for all treatment strategies as shown in Table A-3.

A more condensed summary of the estimated water pollution control costs per cwt. as presented in Table A-3 are shown in Table A-4. The costs are shown in relation to either the BPT or BAT levels of control.

Using the computed wholesale values above, the percent price increases required to recover the control costs (as indicated in Table A-4) are as presented in Table A-5.

Table A-4. Summary of estimated water pollution control costs per cwt. of product for small and large frozen and dehydrated potato processing plants [1]

Type of Product and Plant Size	Range of Control Costs per Cwt.		
	BPT	BAT	"D" (Both)
	($/cwt)	($/cwt)	($/cwt.)
Frozen Potato Products			
Small Plant (400 TPD)	.22-.25	.29-.33	.21
Large Plant (1,000 TPD)	.17-.21	.24-.27	.21
Dehydrated Potato Products			
Small Plant (350 TPD)	.37-.41	.51-.58	.30
Large Plant (1,000 TPD)	.28-.33	.37-.42	.28

[1] Summarized from Table A-1. BPT level involves treatment strategies C or E; BAT involves C, F or G; and D meets both BPT and BAT requirements.

Table A-5. Summary of estimated percentage increases in wholesale processed potato prices needed to recover proposed water pollution control costs

Type of Product and Plant Size	Approx. Wholesale Value/cwt	Percent Increase in Price Needed to Recover Pollution Control Costs 1/		
		BPT	BAT	"D"(Both
		(%)	(%)	(%)
Frozen Potato Products	$17.20			
Small Plant (400 TPD)		1.3-1.5	1.7-1.9	1.2
Large Plant (1,000 TPD)		1.0-1.2	1.4-1.6	1.2
Dehydrated Potato Products	$31.00			
Small Plant (350 TPD)		1.2-1.3	1.6-1.9	1.0
Large Plant(1,000 TPD)		0.9-1.1	1.2-1.4	0.9

[1/] Ranges based on alternative treatment strategies as provided: BPT involves alternatives B and E; BAT involves C, F. or G; and D meets both BPT and BAT requirements as previously described.

For frozen potato products plants, the range of estimated price increases are from 1.0 to 1.5% for BPT control and from 1.2 to 1.9% for BAT control. These ranges include small and large plants as defined. The higher percentages reflect small plant impacts, but it is noted that "small" plants, as defined, are not impacted on a unit cost basis as severely as generally expected relative to the large plants.

For the dehydrated potato products plants, similar price increase estimates range from .9 to 1.3% for BPT control and from .9 to 1.9% for BAT control. As further illustrated in Table A-5, the differential impacts among small and large plants are not extremely large based on the control cost data provided.

Further weighting of the percentage price increases to reflect possible combinations of treatment strategies which might be used, and/or to reflect proportions of pack by small and large plants could be applied to the data developed. However, given the reliability of present information regarding the potato processing industry, such additional calculations are not warranted. The intent of this supplemental analysis is to provide a preliminary assessment of expected impacts despite very limited availability of desired industry data.

Additional Considerations

The above "price effects" are intended only to reflect the general order of magnitude of price increases which might be involved as a consequence of the proposed effluent limitation guidelines.[1/] There are various additional related effects which are even more tenuous given available information. For example, probable plant shutdowns because of financial effects and/or production curtailments cannot be specifically assessed. Neither is it possible to evaluate expected employment effects and community effects which would likely accompany plant shutdowns.

While the related effects cannot be directly estimated, it is noted that the preliminary price effects are of a magnitude which is similar to those of other fruit and vegetable processing industries. In other words, potato processors do not appear to face control costs on a unit basis which are relatively greater than those of other types of fruit and vegetable processors.

[1/] As noted below, about 60 percent of the potato processors are estimated to either have municipal sewer hook-ups or land disposal systems in place. The price effects described assumed no pollution controls in place. Thus, the industry-wide consequences would be less than the effects described.

As reported in Table VI-8, it is further noted that about 60 percent of the potato processors are estimated to currently have either municipal sewer hook-ups (12%) or land irrigation disposal systems (47%). Another 31 percent are estimated to have some biological treatment practices, and only 10 percent are indicated to have no treatment at present (based on sample data only).

Industry-wide impacts of pollution control costs will be mitigated substantially because of the relatively high percentages of plants which have either municipal or land disposal systems. The former plants are not directly affected by the proposed guidelines, and the latter plants employ a treatment strategy which is acceptable under the proposed guidelines.

Based on materials presented in Chapter II, 103 potato processing plants were identified by type as follows:

Type of Potato Processing Plant	Number, 1972
Freezer	32
Dehydrator	6
Freezer and Dehydrator	8
Canner and Freezer	6
Canner and Dehydrator	2
Canner only	49
	103

These data were obtained from The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73. This source of plant data is not necessarily exhaustive, especially for potato dehydrators. Additional study is needed to more completely identify potato processors in the U.S. (A total of 114 processing plants were indicated in Table II-7 in the Ben Holt Co. report, but not specified by type of process.)

A much more thorough analysis and assessment of expected impacts of water pollution control costs on the potato processing industry are desired and recommended. Data which does not now exist on an industry-wide basis need to be developed. This is only possible with the close cooperation of industry sources.

In conclusion, the level of expected price effects as suggested in this preliminary analysis indicates that the potato processing industry will not likely be impacted severely relative to other food processing industries. Too, extreme differential impacts among varied sizes of plants are not indicated.